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### 10<sup>th</sup> ANNUAL CMMI TECHNOLOGY CONFERENCE AND USER GROUP

"Investigation, Measures, and Lessons Learned About the Relationship Between CMMI Process Capability and Project or Program Performance"

Denver, CO

15 - 18 November 2010

Agenda

Tuesday, November 16, 2010

#### **Keynote Speaker**

Mr. Terence Edwards, Director, System-of-Systems Engineering (SoSE), ASA(ALT)

### **CMMI® Implementation Strategies for Success Panel**

- Ms. Nancy Fleishcher, Raytheon Company
- Mr. Rick Bennett, Director of Development, MedPlus
- Mr. Steve Austin, Lockheed Martin Mission

#### **CMMI® V1.3 Overview**

• Mr. Mike Phillips, Software Engineering Institute

#### **BENEFITS OF CMMI**

• Mr. Hal Wilson, Director, Engineering, Defense Systems Division

### **Concurrent Sessions**

### TRACK 1- CHASM CREEK- CMMI AND PROCESS IMPROVEMENT

- 11314 CMMI® in the Social Media (For the Social Media-Challenged!), Mr. Bill Smith, Leading Edge Process Consultants, LLC
- 11315 What Doesn't Kill You Makes You Stronger: My Process Improvement Lessons Learned, Mr. Bill Smith, Leading Edge Process Consultants, LLC
- 11318 NASA's Use of the CMMI® for Software Engineering Improvement, Dr. John Kelly, NASA
- 11297 Applying Theory of Constraints Tools to Focus Lean Development, Mr. Tim Oltman, The Boeing Company

### TRACK 2 – WINDSTAR – PRACTICAL GUIDANCE

- 10963 Configuration Management, Mr. Al Florence, The MITRE Corporation
- 10970 Using CMMI® Effectively in Small Business, NDIA CMMI® Working Group
- 11158 Process Alignment—From Acquired to Acquirer, Ms. Ilene Pinsker, Rockwell Collins

### TRACK 3 - MESA VERDE - PERFORMANCE RESULTS

- 11307 Process Performance Models for Hardware Engineers, Mr. Tom Fosness, Northrop Grumman Corporation
- 11185 Navigating the Waters of SCAMPI Reappraisal, Mr. Craig Hale, AVISTA, Inc. (Part 1, Part 2, Handout)
- 10708 Developing Process Performance Models and Baselines for a Quality Engineering Organization, Dr. Jeff Ricketts, Raytheon Company

### TRACK 4 – HIGHLANDS – APPRAISALS

- 11150 A Real-Life Example of Appraising and Interpreting CMMI® —Services Maturity Level 2, Mr. Neil Potter, The Process Group
- 11308 Effectively Managing Process Compliance, Mr. Joseph Morin, Integrated System Diagnostics, Inc.
- 11299 Leaner SCAMPI Preparation, Mr. Gary Natwick, Harris Corporation

• 11202 - PIID Strategies in a Changing Environment, Mr. Sam Fogle, ACE Guides, LLC

#### TRACK 5 - WIND RIVER - CMMI V1.3

• 11296 - CMMI® V1.3: The Rest of the Story: Changes at CL/ML 1-3, Dr. Mike Konrad, Software Engineering Institute

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### Wednesday, November 17, 2010

### **Concurrent Sessions**

#### TRACK 1 - CHASM CREEK- CMMI® AND PROCESS IMPROVEMENT

- 11305 Turning a Super Tanker: Process Improvement Change at NSA, Mr. Steven Tobin, Dynamics Research Corporation
- 11182 *EPG Pushing Past the Conflicts*, Ms. Evelyn Livermore, ARA, Inc.
- 11309 Value Based Product Development, Mr. Phillip Hohn, ITT ES
- 11204 Managing CMMI Practice Implementation Across Diverse Distributed Environments in Small Organizations, Dr. Mary Anne Herndon, Transdyne Corporation
- 11209 CMMI Bottoms Ups Assessment: A Grounded Analysis from the Perspective of Practicing Engineers in Defense Engineering, Dr. Bruce Beadell, General Dynamics
- 11339 Architecture for Enterprise Process Improvement, Ms. Joan Weszka, Lockheed Martin Corporation
- 11221 *Improvement by the Numbers*, Ms. Debra Perry, Harris Corporation
- 11147 Multi-Model Organizational Process Quality Assurance Program, Ms. Kristin Kingland Glowaski, Kingland Systems Corporation

#### TRACK 2 - WIND STAR - PRACTICAL GUIDANCE

- 11161 The Tailoring Dilemma, Mr. Alan Gellis, The Boeing Company
- 11270 Vertically Slicing the CMMI, Mr. David Dickinson, Northrop Grumman Corporation
- 10969 CMMI for Executives, NDIA CMMI Working Group
- 11284 Measurement Planning and Data Collection, Mr. William Golaz, Lockheed Martin Corporation
- 11317 Experience Report On A method To Predict Software Quality Early in the Software Development Lifecycle and Produce Secure Software, Mr. Girish Seshargiri, AIS
- 11331 A CMMI Compliant Project Plan (In Less Than 10 Pages), Mr. Ferol Lewis, Northrop Grumman Corporation
- 10723 Using CMMI to Integrate and Improve the Enterprise, Mr. Phillip Wah, Jr., The Boeing Company
- 10779 CMMI The Way It Should Be, Mr. Bradley Bittorf, Raytheon Missile Systems

### TRACK 3 - MESA VERDE - PERFORMANCE RESULTS

- 10778 High Maturity Heresy Doing Level 5 before Level 4 without "Data", Mr. Tom Lienhard, Raytheon Company
- 10791 Why CMMI Maturity Level 5?, Mr. Michael Campo, Raytheon Company
- 10793 Horizontal Segmentation of Process Performance Model, Mr. Michael Campo, Raytheon Company
- 10968 CMMI For Executives, NDIA CMMI Working Group
- 11316 Experience Report: Lean Implementation of Organizational Process Focus (OPF) and Risk Management (RSKM) CMMI Process Areas in Agile Environment, Mr. Ahmed Mahdy, Raya Software
- 10699 Improving Performance Through Process Improvement, Mr. Michael West, Natural SPI, Inc.
- 11272 Get It Sold, Keep It Sold: Making the Business Case for High Maturity, Dr. Richard Welch, Northrop Grumman Corporation
- 11290 Benefits and Performance Improvements with CMMI How to Increase Your Project Data Usability, Mr. Kobi Vider, K.V.P Counsulting

### TRACK 4 - HIGHLANDS - APPRAISALS

- 11153 Appraisals and CMMI Gotchas- Lessons in CMMI Use and Appraisal Preparations, Mr. Neil Potter, The Process Group
- 11192 Disruptive Appraisals Prohibited, Ms. Kelly Lanier, Raytheon Company
- 11265 In Search of Higher Quality at Lower Costs, Ms. Margaret Corr, General Dynamics
- 11321 Use of a Standard Approach Lessons Learned in Identifying Objective Evidence for the PIID, Ms. Pamela Hudson, Lockheed Martin Corporation

### TRACK 4 - HIGHLANDS - ACQUISITIONS

- 10550 Leveraging Capability Maturity Model Integration for Acquisition (CMMI-ACQ) Processes to Improve Organizational Workforce and System Acquisition Performance, Dr. Kenneth Nidiffer, Software Engineering Institute
- 11293 Using the SEI Models and Practices to Assure the System Lifecycle Deliverables Quality and Compatibility, Mr. Kobi Vider, K.V.P. Consulting
- 11328 Systems Asssurance, The Global Supply Chain, and Efforts To Increase Communication Between Acquisition and Development, Ms. Michele Moss, Booz Allen Hamilton

#### TRACK 5 - WIND RIVER - CMMI® V1.3

- 11364 CMMI DEV V1.3 Pilot Good, Bad & Ugly, Mr. Jackie Lawrence, ISD, Inc
- 11329 Tips and Hints for CMMI V1.3, Ms. Mary Beth Chrissis, Software Engineering Institute
- 10930 CMMI Version 1.3 High Maturity Panel We Thought but Now We Know, Ms. Mary Lynn Penn, Lockheed Martin Corporation
- 10986 Pilot for CMMI Dev V1.3 High Maturity Process Areas, Ms. Doma Witkowski, Lockheed Martin Corporation
- 10714 CMMI and Micro Focus' AVP A Dynamic Duo in Optimizing IT Business Value!, Mr. Pete Dupre', MicroFocus

• 11211 – The Perils of Agile, but...., Ms. Dorothy Acton, Lockheed Martin Corporation

### TRACK 5 - WIND RIVER - CMMI® AND AGILE/LEAN

- 11152 Comparing Scrum and CMMI How Can They Work Together?, Mr. Neil Potter, The Process Group
- 11166 Practical Report: CMMI Requirements Development and Management in an Agile Environment, Mr. Ahmed Mahdy, Raya Corporation

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### Thursday, November 18, 2010

### **Concurrent Sessions**

#### TRACK 1 - CHASM CREEK- CMMI® AND PROCESS IMPROVEMENT

- 10987 Applying CMMI SVC to Process Management, Ms. Doma Witkowski, Lockheed Martin Corporation
- 11141 Improving Operational Resilence Processes, Mr. Richard Barbour, Software Engineering Institute
- 10701 Making Process Deployment and Monitoring Work, Ms. Susan Byrnes, Natural SPI, Inc
- 11319 *Proactive Process Deployment is Key to Institutionalization*, Ms. Pamela Hudson, Lockheed Martin Corporation

### TRACK 2 - WIND STAR - PRACTICAL GUIDANCE

- 11285 Deployment of Measurement and Analysis at a large Multisite company, Mr. William Golaz, Lockheed Martin Corporation
- 11273 Divide and Conquer Marshaling the "Masses" to Tackle CMMI, Mr. Robert Tuthill, Northrop Grumman Corporation

### TRACK 3 - MESA VERDE - PERFORMANCE RESULTS

- 11292 The Issue of Performance Why Do You Need A Maturity Level 5, Mr. Kobi Vider, K.V. P Consulting
- 11310 *Performance Effects of Measurement and Analysis*, Dr. Dennis Goldenson, Software Engineering Institute
- 11177 Connecting the Dots: QPM, OPP, CAR and OID, Ms. Diane Mizukami-Williams, Northrop Grumman Corporation

### TRACK 4 - HIGHLANDS - ACQUISITIONS

- 10942 How Can I Establish A Process Architecture and Use It Effectively?, Dr. Gary Palosaari, The Boeing Company
- How MBE can support Requirements Development and Technical Solution, Mr. Frank Salvatore, High Performance Technologies, Inc
- 11165 A Streamlined Approach to SW Estimating Using Cocomo II, Mr. John Rossi, Rockwell Collins
- 10599 Systems Engineering Processes Improvement Using the CMMI in Large System of Systems Space Programs, Ms. Sarit Assaraf, Israel Aerospace Industries

### TRACK 5 - WIND RIVER - CMMI® AND AGILE/LEAN

- 11213 *Using the Agile Methodology to Mitigate the Risks of Highly Adaptive Projects*, Ms. Dana Roberson, Transdyne Corporation
- 11323 Lean Development Influencing the Organization, Mr. Carl Gaul, The Boeing Company
- 11324 Lean Development Selecting the Right Tools for Maximum Success, Mr. Carl Gaul, The Boeing Company

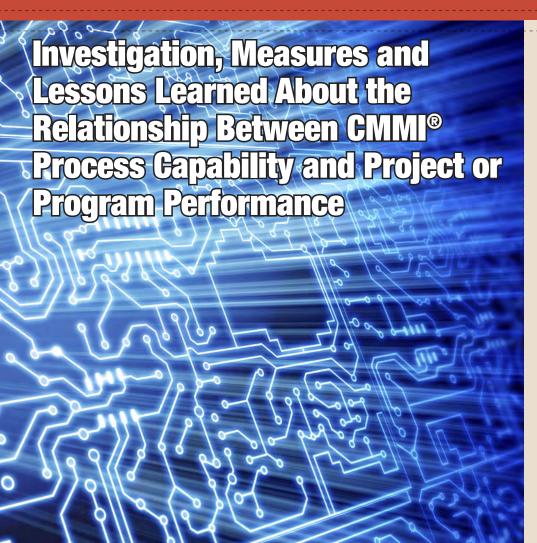


# 10<sup>TH</sup> ANNUAL CMMI® TECHNOLOGY **CONFERENCE AND USER GROUP**





- Software Engineering Institute | Carnegie Mellon



### SPONSORED BY:

NATIONAL DEFENSE INDUSTRIAL **ASSOCIATION SYSTEMS ENGINEERING DIVISION** IN CONJUNCTION WITH:



### Software Engineering Institute Carnegie Mellon

This conference brings together the managers and professionals involved in Acquisition Management, Systems Engineering, Program Management, Software Development, Process Improvement, Six Sigma and related activities for the purpose of advancing the state-of-the-art in process improvement and achieving a higher state of process capability in engineering development in order to reduce cost, schedule and risk, and improve overall quality.

### Who Should Attend?

Defense, aerospace and commercial companies, CMMI® Transition Partners, Department of Defense organizations, small companies specializing in software and systems engineering development, tools and processes, acquisition, or services, and other government agencies.

#### What Will Be Presented?

A wide variety of presentations, including the new CMMI® for Services, integrated process improvement, Lean/Agile and Six Sigma approaches, and evolving approaches and lessons learned involving SCAMPISM appraisal methods. The latest state of the CMMI° V.3 release will be presented and questions answered.

# CMMI® TECHNOLOGY CONFERENCE AND USER GROUP

# **HYATT REGENCY TECH CENTER** ➤ **DENVER, COLORADO NOVEMBER 15-18, 2010**

The CMMI® was developed in cooperation with the Department of Defense, Industry and the Software Engineering Institute, and has become the defacto standard for integrated process improvement across multiple disciplines within commercial, Department of Defense and government organizations. Although sponsored by the Department of Defense and NDIA, the CMMI® is used by commercial as well as government and industry organizations, and this conference will address all applications. The purpose of CMMI® is to provide for improvements in cost, schedule and overall performance of projects in engineering, acquisition, and services by eliminating "stovepipe" maturity models and allowing organizations to integrate their process improvement efforts. CMMI® has been shown to reduce costs, to implement internal process improvement, including appraisals (assessments and evaluations) and provide a common baseline and lexicon for process improvement.

### **LODGING**

A block of rooms has been reserved at the Hyatt Regency Denver Tech Center. The government per diem rate is \$141 U.S. (\*Or the prevailing government per diem at the time of the conference). The industry rate is \$167.00 US.

In order to ensure the discounted NDIA rate, please make reservations early and ask for the NDIA room block. Rooms will not be held after October 23, 2010 and may also sell out before then. Rates are subject to increase after this date.

\*The per diem rate is available only to active duty or civilian government employees. ID will be required upon check-in. Retired military or government civilians do not qualify for the government rate.

Government Attendees: Any active U.S. Military attendee with ID and travel order will be tax exempt (subject to state's regulation of tax exemption). Any U.S. Government employee paying with U.S. Government check or credit card will be tax exempt (with supporting documentation as required by some states). Check with the hotel for specific state and local requirements when booking hotel reservations.

# **SPECIAL NEEDS**

NDIA supports the Americans with Disabilities Act of 1990. Attendees with special needs should call Kelly Seymour at (703) 247-2583 prior to November 5, 2010.

### **CONFERENCE ATTIRE**

Appropriate dress for this conference is business for civilians (coat and tie) and class A uniform or uniform of the day for military.

# **ANNOUNCEMENT**

The National Defense Industrial Association, Systems Engineering Division, in conjunction with the Software Engineering Institute, Carnegie Mellon University, is pleased to announce the 10th Annual CMMI® (Capability Maturity Model Integration) Technology Conference & User Group. This premier conference will be held November 15-18, 2010, at the Hyatt Regency Tech Center in Denver, Colorado.

The purpose of the conference is to exchange ideas, concepts and lessons learned concerning the continuing evolution, adoption and use of the CMMI® and its associated appraisal (assessment and evaluation) methods. This conference brings together CMMI® adopters, users, developers and appraisers, as well as those with general interest in process improvement. It provides a forum for the free exchange of ideas and affords a unique opportunity to meet with the sponsors, developers and stewards of the CMMI®, as well as those offering CMMI® training and implementation assistance. Emphasis will be placed on CMMI® implementation methods and strategies, return on investment and program/project performance benefits.

# **CONTACTS**

Ms. Kelly Seymour, Meeting Planner, kseymour@ndia.org, (703) 247-2583

Conference Chair: Mr. Bob Rassa, Director, Systems Support, Raytheon Company, rcrassa@raytheon.com, (310) 985-4962

Technical Program Chairs: Mr. Rick Barbour, Software Engineering Institute, reb@sei.cmu.edu; Brian Gallagher, Northrop Grumman Corporation, Brian. Gallagher@ngc.com

# PROMOTIONAL PARTNERSHIPS

Increase your company or organization's exposure at this premier event by becoming a Promotional Partner. A Promotional Partnership (\$5,000) will add your company name to the back cover of the on-site brochure as well as main podium recognition throughout the conference, signage at all events including the opening reception, and a 350-word organization description in the conference agenda. For more information, please contact Sam Campagna at 703-247-2544 or scampagna@ndia.org or Kelly Seymour at 703-247-2583 or kseymour@ndia.org.

# **DISPLAYS**

An area will be available for the setup of company or organization displays to demonstrate unique tools or capability in process improvement, transition partner activities, software and systems engineering tools and related capability. The registration fee of \$1,800 includes one individual registration, table, chair and electrical hook-up. Displays will be tabletop or "pop-up" style. Allocated display space will be 10 ft. wide by 6 ft. deep. Pipe and drape will be provided. Although computer systems for demonstration are allowed, minimal hardware should be utilized. No formal decorating company will be involved. Companies must bring their own displays and plan to do their own set-up. Standard draped folding table and chair will be provided for each display space.

Display setup will begin Monday, November 15 at 7:00 am in the Second Floor Atrium of the Hyatt Regency Denver Tech Center. Display location is on a first-come, first-served basis and the locations are not assigned ahead of time. Displays are to be set by 4:00 pm on Monday, November 15 and must remain in place until the morning break on Thursday, November 18. Displays must be removed by 2:00 pm on Thursday, November 18.

Visit www.ndia.org/meetings/1110 to download the Display Registration Form.

# MONDAY, NOVEMBER 15, 2010 TUTORIAL REGISTRATION

Tutorials provide a broad range of informative topics that will enable a better understanding and usage of elements of the CMMI® product suite. This includes understanding the CMMI®-ACQ and CMMI®-SVC as well as practical guidance and experience in applying the CMMI® model. These tutorials also include experience in incorporating supporting techniques such as lean methods and processes, and EVM.

| TUTORIAL            | REGULAR        | LATE         |
|---------------------|----------------|--------------|
| REGISTRATION FEES   | (BEFORE 11/05) | (AFTER 11/5) |
| INDUSTRY/GOVERNMENT | \$250          | \$275        |

# TUESDAY, NOVEMBER 16 - THURSDAY, NOVEMBER 18

# CMMI® CONFERENCE REGISTRATION

Register online by visiting the conference website at www.ndia.org/meetings/1110. Online registration will close at 5:00 pm EST on November 5, 2010. You may also fax the registration form found in this brochure to (703) 522-1885 or mail it to National Defense Industrial Association, Event #1110, 2111 Wilson Blvd., Suite 400, Arlington, VA, 22201. Payment must be made at the time of registration. Registrations will not be taken over the phone.

| CONFERENCE<br>REGISTRATION FEES     | EARLY<br>(ON/BEFORE 10/01) | REGULAR<br>(10/02-11/05) | LATE<br>(AFTER 11/05) |
|-------------------------------------|----------------------------|--------------------------|-----------------------|
| GOVERNMENT/<br>ACADEMIA/ALLIED GOV. | <b>\$750</b>               | \$825                    | \$930                 |
| INDUSTRY<br>NDIA MEMBER             | \$850                      | \$935                    | \$1050                |
| INDUSTRY<br>NON-NDIA MEMBER         | <b>\$970</b>               | \$1070                   | \$1180                |

**Cancellations** received on or before 11/5/10 will receive a refund minus a \$75 cancellation fee. No refunds will be given for cancellations after 11/5/10. Substitutions are welcome in lieu of cancellations. Cancellations and substitutions must be made in writing to kseymour@ndia.org.



# **SUNDAY, NOVEMBER 14, 2010**

4:00 pm - 6:00 pm Registration Open

Located in Mesa Verde Foyer, 1st Floor

# **MONDAY, NOVEMBER 15, 2010**

7:00 am - 6:00 pm

**Registration Open** 

Located in Mesa Verde Foyer, 1st Floor

7:00 am - 8:00 am

**Continental Breakfast (Tutorial Attendees Only)** 

Located in Wind Star Foyer, 1st Floor

8:00 am - 5:00 pm

**Tutorial Sessions (Tutorial Attendees Only: Additional Cost** 

Required)

9:45 am - 10:15 am

**Break (Tutorial Attendees Only)** Located in Wind Star Foyer, 1st Floor

11:45 am - 1:00 pm

**Lunch (Tutorial Attendees Only)** 

Located in Centennial, 12th Floor

2:45 pm - 3:15 pm

**Break (Tutorial Attendees Only)** 

Located in Wind Star Foyer, 1st Floor

5:00 pm - 6:00 pm

**Reception (Open to ALL ATTENDEES)** Located in Atrium Display Area, 2nd Floor

# **TUESDAY, NOVEMBER 16, 2010**

7:00 am - 6:00 pm

**Registration Open** 

Located in Mesa Verde Foyer, 1st Floor

7:00 am - 8:00 am

**Continental Breakfast** 

Located in Atrium Display Area, 2nd Floor

8:00 am - 8:15 am

8:15 am - 9:00 am

**Welcome and Opening Remarks** 

Located in Grand Mesa ABC, 2nd Floor

► Mr. Sam Campagna, Assistant Vice President, Operations, NDIA

► Mr. Bob Rassa, Director, Engineering Programs, Raytheon Company

Located in Grand Mesa ABC, 2nd Floor

► Mr. Terence Edwards, *Director, System-of-Systems Engineering (SoSE)*,

ASA(ALT)

9:00 am - 10:15 am

**CMMI®** Implementation Strategies for Sucess Panel

Located in Grand Mesa ABC, 2nd Floor

**Moderator:** Mr. Bob Rassa, *Director, Engineering Programs, Raytheon* 

Company

► Ms. Nancy Fleishcher, *Raytheon Company* 

► Ms. Juliet Davis, *The Boeing Company* 

► Mr. Paul Zavidniak, Northrop Grumman Corporation

► Ms. Bettina Schechter, Lockheed Martin Mission Systems & Sensors (MS2)

10:15 am - 10:30 am Break

Located in Atrium Display Area, 2nd Floor

10:30 am - 11:15 am CMMI® V1.3 Overview

► Mr. Mike Phillips, *Software Engineering Institute* 

11:15 am - 12:10 pm BENEFITS OF CMMI®

Located in Grand Mesa ABC, 2nd Floor

► Mr. Hal Wilson, Director, Engineering, Defense Systems Division, Northrop Grumman

► Mr. Bob Rassa, Director, Engineering Programs, Raytheon Company

12:10 pm - 12:30 pm Q&A

12:30 pm - 1:30 pm Lunch

Located in Grand Mesa F, 2<sup>nd</sup> Floor

**Concurrent Sessions** 1:30 pm - 3:00 pm

3:00 pm - 3:30 pm **Break** 

Located in Atrium Display Area, 2<sup>nd</sup> Floor

**Concurrent Sessions** 3:30 pm - 5:00 pm

5:30 pm - 6:30 pm Reception

Located in Atrium Display Area, 2nd Floor

# **WEDNESDAY, NOVEMBER 17, 2010**

7:00 am - 4:30 pm

**Registration Open** 

Located in Mesa Verde Foyer, 1st Floor

7:00 am - 8:00 am

**Continental Breakfast** 

Located in Atrium Display Area, 2<sup>nd</sup> Floor

8:00 am - 9:30 am

**Concurrent Sessions** 

9:30 am - 10:00 am

**Break** Located in Atrium Display Area, 2<sup>nd</sup> Floor

10:00 am - 11:30 am Concurrent Sessions

11:30 am - 1:00 pm

**Awards Lunch** 

Located in Grand Mesa F, 2nd Floor

1:00 pm - 2:30 pm

**Concurrent Sessions** 

2:30 pm - 3:00 pm

**Break** 

Located in Atrium Display Area, 2<sup>nd</sup> Floor

3:00 pm - 4:30 pm

**Concurrent Sessions** 

4:30 pm

Conference adjourns for the day

# THURSDAY, NOVEMBER 18, 2010

7:00 am - 11:30 am Registration Open

Located in Grand Mesa Foyer, 2<sup>nd</sup> Floor

7:00 am - 8:00 am

**Continental Breakfast** 

Located in Atrium Display Area, 2<sup>nd</sup> Floor

8:00 am - 9:30 am

**Concurrent Sessions** 

9:30 am - 10:00 am

**Break** 

Located in Atrium Display Area, 2nd Floor

10:00 am - 11:30 am Concurrent Sessions

11:30 am - 2:00 pm

**Display Dismantle** 

11:30 am

**Conference adjourns** 

\*\*Please note that the agenda is subject to change\*\*

# MONDAY, NOVEMBER 15, 2010

|                      | Track 1  | Track 2   | Track 3   | Track 4  | Track 5   |  |
|----------------------|--|---|---|--|---|--|
|                      | Chasm Creek  | Wind Star   | Mesa Verde  | Highlands  | Wind River  |  |
| 8:00 am -            | 1A1 - Tutorial   | 1A2 - Tutorial  | 1A3 - Tutorial  | 1A4 - Tutorial   | ® — Values and Principles   |  |
| 9:45 am Session A    | 10924 - CMMI® V1.3—<br>What's New?                         | 10960 - Risk<br>Management and Beyond   | 11151 - Making Process<br>Improvement Work —<br>Tying Improvement and<br>CMMI® Directly to What<br>You Care About | 11274 - Applying Lean<br>Principles to CMMI®<br>Implementations to<br>Achieve More ROI |   |  |
|                      | Mr. Mike Phillips,<br>Software Engineering<br>Institute    | Mr. Al Florence, The<br>MITRE Corporation                                     | Mr. Neil Potter, The<br>Process Group   | Mr. Tim Olson, Lean Mr. Tim Kasse, Ka. Solutions Institute, Inc. Initiatives, LLC      |   |  |
| 10:15 am -           | 1B1 - Tutorial (Con't)                                     | 1B2 - Tutorial (Con't)  | 1B3 - Tutorial (Con't)  | 1B4 - Tutorial (Con't)   | 1B5 - Tutorial (Con't)  |  |
| 11:45 am Session B   | 10924 - CMMI® V1.3—<br>What's New?                         | 10960 - Risk<br>Management and Beyond   | 11151 - Making Process<br>Improvement Work —<br>Tying Improvement and<br>CMMI® Directly to What<br>You Care About | 11274 - Applying Lean<br>Principles to CMMI®<br>Implementations to<br>Achieve More ROI | 11262 - SPI Manifesto<br>— Values and Principles  |  |
|                      | Mr. Mike Phillips,<br>Software Engineering<br>Institute    | Mr. Al Florence, The<br>MITRE Corporation                                     | Mr. Neil Potter, The<br>Process Group   | Mr. Tim Olson, Lean<br>Solutions Institute, Inc.                                       | Mr. Tim Kasse, Kasse<br>Initiatives, LLC  |  |
|                      | Break in Wind Star Foyer, 1st Floor                        |   |   |  |   |  |
| 1:00 pm -            | 1C1 - Tutorial   | 1C2 - Tutorial  | 1C3 - Tutorial  |  | 1C5 - Tutorial  |  |
| 2:45 pm<br>Session C | 11203- CMMI® V1.3<br>and Architecture  Dr. Lawrence Jones, | 11288 - Strategic<br>Technology and<br>Operational Risk<br>Management (STORM) | 10962 - Life Cycle<br>Configuration<br>Management   |  | 11263 - Effective<br>Technology Transition<br>Techniques That Make<br>Process Improvement<br>Happen |  |
|                      | Software Engineering<br>Institute                          | Mr. Kobi Vider, K.V.P<br>Consulting   | Mr. Al Florence, The<br>MITRE Corporation   |  | Mr. Tim Kasse, Kasse<br>Initiatives, LLC  |  |
| 3:15 pm -            | 1D1 - Tutorial (Con't)                                     | 1D2 - Tutorial (Con't)  | 1D3 - Tutorial (Con't)  |  | 1D5 - Tutorial (Con't)  |  |
| 5:00 pm<br>Session D | 11203- CMMI® V1.3<br>and Architecture                      | 11288 - Strategic<br>Technology and<br>Operational Risk<br>Management (STORM) | 10962 - Life Cycle<br>Configuration<br>Management   |  | 11263 - Effective<br>Technology Transition<br>Techniques That Make<br>Process Improvement<br>Happen |  |
|                      | Dr. Lawrence Jones,<br>Software Engineering<br>Institute   | Mr. Kobi Vider, K.V.P<br>Consulting   | Mr. Al Florence, The<br>MITRE Corporation   |  | Mr. Tim Kasse, Kasse<br>Initiatives, LLC  |  |

<sup>\*\*</sup>Additional Cost Required\*\*

# **TUESDAY, NOVEMBER 16, 2010**

|                      | Track 1  | Track 2  | Track 3  | Track 4  | Track 5   |
|----------------------|--|--|--|--|---|
|                      | Chasm Creek  | Wind Star  | Mesa Verde   | Highlands  | Wind River  |
|                      | CMMI® and Process<br>Improvement   | Practical Guidance   | Performance Results  | Appraisals   | CMMI® V1.3  |
|                      | Session Chairs:<br>Ms. Susan Bassham,<br>U.S. Army   | Session Chairs:<br>Mr. Geoff Draper, Harris<br>Corporation, Ms. Diane<br>Mizukami Williams,<br>Northrop Grumman<br>Corporation | Session Chair: Mr. Dennis Goldenson, Software Engineering Institute, Mr. Ken Weinberg, Raytheon Company  | Session Chairs: Ms. Lorraine Adams, Software Engineering Institute & Mr. Mike Phillips, Software Engineering Institute | Session Chair: Mr. Ken Nidiffer, Software Engineering Institute, Mr. Charles Ryan, Software Engineering Instititute |
| 1:30 pm -<br>2:15 pm | 11314 - CMMI® in the<br>Social Media (For the<br>Social Media-Challenged!<br>Mr. Bill Smith, Leading | 10963 - Configuration<br>Management  | 11307 - Process<br>Performance Models for<br>Hardware Engineers  | 11150 - A Real-Life Example of Appraising and Interpreting CMMI® —Services Maturity Level 2                            | 11296 - CMMI® V1.3:<br>The Rest of the Story:<br>Changes at CL/ML 1-3   |
|                      | Edge Process Consultants,<br>LLC   | Mr. Al Florence, The<br>MITRE Corporation  | Mr. Tom Fosness, Northrop<br>Grumman Corporation   | Mr. Neil Potter, The<br>Process Group  | Software Engineering<br>Institute   |
| 2:15 pm -<br>3:00 pm | 11315 - What Doesn't Kill<br>You Makes You Stronger:<br>My Process Improvement<br>Lessons Learned    | 10970 - Using CMMI®<br>Effectively in Small<br>Business  | 11185 - Navigating<br>the Waters of SCAMPI<br>Reappraisal  | 11308 - Effectively<br>Managing Process<br>Compliance  | 11327 - Questions<br>and Answers with the<br>SCAMPI Upgrade Team  |
|                      | Mr. Bill Smith, Leading<br>Edge Process Consultants,<br>LLC  | NDIA CMMI® Working<br>Group  | Mr. Craig Hale, AVISTA,<br>Inc.  | Mr. Joseph Morin,<br>Integrated System<br>Diagnostics, Inc.  | Mr. Will Hayes, Software<br>Engineering Institute   |
|                      |  | Break in Atriui  | n Display Area, 2 <sup>nd</sup> Flo  | or   |   |
|                      | CMMI® and Process<br>Improvement   | Practical Guidance   | Performance Results  | Appraisals   | CMMI® V1.3  |
|                      | Session Chairs:<br>Ms. Susan Bassham,<br>U.S. Army   | Session Chairs:<br>Mr. Geoff Draper, Harris<br>Corporation, Ms. Diane<br>Mizukami Williams,<br>Northrop Grumman<br>Corporation | Session Chair: Mr. Dennis Goldenson, Software Engineering Institute, Mr. Ken Weinberg, Raytheon Company  | Session Chairs: Ms. Lorraine Adams, Software Engineering Institute & Mr. Mike Phillips, Software Engineering Institute | Session Chair:<br>Mr. Ken Nidiffer,<br>Software Engineering<br>Institute  |
| 3:30 pm -<br>4:15 pm | 11318 - NASA's Use of<br>the CMMI® for Software<br>Engineering Improvement                           | 11340 - Risk<br>Management - How<br>QPM Saved the Day  | 11338 - From Denial<br>to Commitment—<br>Quantitative Chronicles of<br>an Organization's Cultural<br>Change During its<br>Journey Towards Higher<br>Maturity | 11299 - Leaner SCAMPI<br>Preparation   | 11334 - Scoping<br>Appraisals Using SCAMPI<br>V1.3  |
|                      | Dr. John Kelly, NASA   | Ms. Deepti Sharma, OST   | Ms. Kinkini Sarkar, OST  | Mr. Gary Natwick, Harris<br>Corporation  | Mr. Will Hayes, Software<br>Engineering Institute   |
| 4:15 pm -<br>5:00 pm | 11297 - Applying Theory<br>of Constraints Tools to<br>Focus Lean Development                         | 11158 - Process<br>Alignment—From<br>Acquired to Acquirer  | 10708 - Developing<br>Process Performance<br>Models and Baselines<br>for a Quality Engineering<br>Organization   | 11202 - PIID Strategies<br>in a Changing<br>Environment  | 11335 - Using SCAMPI<br>with More than One<br>CMMI® Constellation in<br>the Same Appraisal                          |
|                      | Mr. Tim Oltman, The<br>Boeing Company  | Ms. Ilene Pinsker,<br>Rockwell Collins   | Dr. Jeff Ricketts,<br>Raytheon Company   | Mr. Sam Fogle, ACE<br>Guides, LLC  | Mr. Will Hayes, Software<br>Engineering Institute   |

# **WEDNESDAY, NOVEMBER 17, 2010**

|                        | Track 1   | Track 2   | Track 3   | Track 4  | Track 5   |  |
|------------------------|---|---|---|--|---|--|
|                        | Chasm Creek   | Wind Star   | Mesa Verde  | Highlands  | Wind River  |  |
|                        | CMMI® and Process<br>Improvement  | Practical Guidance  | Performance Results   | Appraisals   | CMMI® V1.3  |  |
|                        | Session Chairs:<br>Ms. Susan Bassham,<br>U.S. Army  | Session Chairs: Mr. Geoff Draper, Harris Corporation, Ms. Diane Mizukami Williams, Northrop Grumman Corporation | Session Chair: Mr. Dennis Goldenson, Software Engineering Institute, Mr. Ken Weinberg, Raytheon Company | Session Chairs: Ms. Lorraine Adams, Software Engineering Institute & Mr. Mike Phillips, Software Engineering Institute | Session Chair: Mr. Ken Nidiffer, Software Engineering Institute, Mr. Charles Ryan, Software Engineering Instititute |  |
| 8:00 am -<br>8:45 am   | 11305 - Turning a<br>Super Tanker: Process<br>Improvement Change<br>at NSA                                    | ess Dilemma Heresy—Doing Level 5 CMMI® Gotchas— V   |   | 11364 - CMMI® - DEV<br>V1.3 Pilot—Good, Bad<br>& Ugly  |   |  |
|                        | Mr. Steven Tobin,<br>Dynamics Research<br>Corporation   | Mr. Alan Gellis, The<br>Boeing Company  | Mr. Tom Lienhard,<br>Raytheon Company   | Mr. Neil Potter, The<br>Process Group  | Mr. Jackie Lawrence,<br>ISD, Inc.   |  |
| 8:45 am -<br>9:30 am   | 11182 - EPG – Pushing<br>Past the Conflicts   | 11270 - Vertically Slicing the CMMI®  | 10791 - Why CMMI®<br>Maturity Level 5?  | 11192 - Disruptive<br>Appraisals Prohibited  | 11329 - Tips and Hints<br>for CMMI® V1.3  |  |
|                        | Ms. Evelyn Livermore,<br>ARA, Inc.  | Mr. David Dickinson<br>Northrop Grumman<br>Corporation  | Mr. Michael Campo,<br>Raytheon Company  | Ms. Kelly Lanier,<br>Raytheon Company  | Mrs. Mary Beth Chrissis,<br>Software Engineering<br>Institute   |  |
|                        |   | Break in Atriu  | m Display Area, 2 <sup>nd</sup> Flo   | oor  |   |  |
|                        | CMMI® and Process<br>Improvement  | Practical Guidance  | Performance Results   | Appraisals   | CMMI® V1.3  |  |
|                        | Session Chairs:<br>Ms. Susan Bassham,<br>U.S. Army  | Session Chairs: Mr. Geoff Draper, Harris Corporation, Ms. Diane Mizukami Williams, Northrop Grumman Corporation | Session Chair: Mr. Dennis Goldenson, Software Engineering Institute, Mr. Ken Weinberg, Raytheon Company | Session Chairs: Ms. Lorraine Adams, Software Engineering Institute & Mr. Mike Phillips, Software Engineering Institute | Session Chair: Mr. Ken Nidiffer, Software Engineering Institute, Mr. Charles Ryan, Software Engineering Institute   |  |
| 10:00 am -<br>10:45 am | 11309 - Value Based<br>Product Development  | 10969 - CMMI® for Executives  | 10793 - Horizontal<br>Segmentation of Process<br>Performance Model                                      | 11265 - In Search of<br>Higher Quality at Lower<br>Costs   | 10930 - CMMI® Version<br>1.3 High Maturity Panel<br>—We Thought but Now<br>We Know                                  |  |
|                        | Mr. Phillip Hohn, ITT ES  | NDIA CMMI® Working<br>Group   | Mr. Michael Campo,<br>Raytheon Company  | Mrs. Margaret Corr,<br>General Dynamics  | Ms. Mary Lynn Penn,<br>Lockheed Martin<br>Corporation   |  |
| 10:45 am -<br>11:30 am | 11204 - Managing CMMI® Practice Implementation Across Diverse Distributed Environments in Small Organizations | 11284 - Measurement<br>Planning and Data<br>Collection  | 10968 - CMMI® for<br>Executives   | 11321 - Use of a<br>Standard Approach—<br>Lessons Learned in<br>Identifying Objective<br>Evidence for the PIID         | 10986 - Pilot for<br>CMMI®-DEV V1.3 High<br>Maturity Process Areas  |  |
|                        | Dr. Mary Anne Herndon,<br>Transdyne Corporation   | Mr. William Golaz,<br>Lockheed Martin<br>Corporation  | NDIA CMMI® Working<br>Group   | Ms. Pamela Hudson,<br>Lockheed Martin<br>Corporation   | Ms. Dorna Witkowski,<br>Lockheed Martin<br>Corporation  |  |

# WEDNESDAY (CONT'D...)

|                      | Track 1  | Track 2   | Track 3  | Track 4  | Track 5   |
|----------------------|--|---|--|--|---|
|                      | Chasm Creek  | Wind Star   | Mesa Verde   | Highlands  | Wind River  |
|                      | CMMI® and Process<br>Improvement   | Practical Guidance  | Performance Results  | Acquisition  | CMMI® and<br>Agile/Lean   |
|                      | Session Chairs:<br>Ms. Susan Bassham,<br>U.S. Army   | Session Chairs: Mr. Geoff Draper, Harris Corporation, Ms. Diane Mizukami Williams, Northrop Grumman Corporation   | Session Chair: Mr. Dennis Goldenson, Software Engineering Institute, Mr. Ken Weinberg, Raytheon Company  | Session Chairs: Ms. Lorraine Adams, Software Engineering Institute & Mr. Mike Phillips, Software Engineering Institute   | Session Chair: Mr. Ken Nidiffer, Software Engineering Institute, Mr. Charles Ryan, Software Engineering Instititute |
| 1:00 pm -<br>1:45 pm | 11209 - CMMI® Bottoms - Up Assessment: A Grounded Analysis from the Perspective of Practicing Engineers in Defense Engineering | 11317 - Experience<br>Report On A Method To<br>Predict Software Quality<br>Early in the Software<br>Development Lifecycle<br>and Produce Secure<br>Software | 11316 - Experience Report: Lean Implementation of Organizational Process Focus (OPF) and Risk Management (RSKM) CMMI® Process Areas in Agile Environment | 10550 - Leveraging Capability Maturity Model Integration for Acquisition (CMMI®-ACQ) Processes to Improve Organizational Workforce and System Acquisition Performance  Dr. Kenneth Nidiffer, | 10714 - CMMI and Micro<br>Focus' AVP — A Dynamic<br>Duo in Optimizing IT<br>Business Value!                         |
|                      | Dr. Bruce Beadell, General<br>Dynamics   | Mr. Girish Seshagiri, AIS   | Mr. Ahmed Mahdy, Raya<br>Software  | Software Engineering Institute   | Mr. Pete DuPre',<br>MicroFocus  |
| 1:45 pm -<br>2:30 pm | 11339 - Architecture<br>for Enterprise Process<br>Improvement  | 11331 - A CMMI®-<br>Compliant Project Plan (in<br>Less Than 10 Pages  | 10699 - Improving<br>Performance Through<br>Process Improvement  | 11293 - Using the SEI<br>Models and Practices<br>to Assure the System<br>Lifecycle Deliverables<br>Quality and Compatibility   | 11211 - The Perils of<br>"Agile, but"   |
|                      | Ms. Joan Weszka,<br>Lockheed Martin<br>Corporation   | Mr. Ferol Lewis, Northrop<br>Grumman Corporation  | Mr. Michael West, Natural<br>SPI, Inc.   | Mr. Kobi Vider, K.V.P<br>Consulting  | Mrs. Dorothy Acton,<br>Lockheed Martin<br>Corporation   |
|                      |  | Break in Atriu  | m Display Area, 2 <sup>nd</sup> Flo  | oor  |   |
|                      | CMMI® and Process<br>Improvement   | Practical Guidance  | Performance Results  | Acquisition  | CMMI® and<br>Agile/Lean   |
|                      | Session Chairs:<br>Ms. Susan Bassham,<br>U.S. Army   | Session Chairs: Mr. Geoff Draper, Harris Corporation, Ms. Diane Mizukami Williams, Northrop Grumman Corporation   | Session Chair: Mr. Dennis Goldenson, Software Engineering Institute, Mr. Ken Weinberg, Raytheon Company  | Session Chairs: Ms. Lorraine Adams, Software Engineering Institute & Mr. Mike Phillips, Software Engineering Institute   | Session Chair: Mr. Ken Nidiffer, Software Engineering Institute, Mr. Charles Ryan, Software Engineering Instititute |
| 3:00 pm -<br>3:45 pm | 11221 - Improvement by<br>the Numbers  | 10723 - Using CMMI® to Integrate and Improve the Enterprise   | 11272 - Get It Sold,<br>Keep It Sold: Making the<br>Business Case for High<br>Maturity   | 11372 - Maritime<br>Surveillance Systems:<br>An Acquisition Program<br>Office's Approach to<br>Continuous Process<br>Improvement   | 11152 - Comparing<br>Scrum And CMMI®—<br>How Can They Work<br>Together?   |
|                      | Mrs. Debra Perry, Harris<br>Corporation  | Mr. Philip Wah, Jr., The<br>Boeing Company  | Dr. Richard Welch,<br>Northrop Grumman<br>Corporation  | Mr. Joe Darwood, TASC  | Mr. Neil Potter, The<br>Process Group   |
| 3:45 pm -<br>4:30 pm | 11147 - Multi-Model<br>Organizational Process<br>Quality Assurance<br>Program  | 10779 - CMMI®—The<br>Way It Should Be   | 11290 - Benefits<br>and Performance<br>Improvements with<br>CMMI®—How to<br>Increase Your Project<br>Data Usability                                      | 11328 - Systems Assurance, The Global Supply Chain, and Efforts To Increase Communication Between Acquisition and Development  | 11166 - Practical Report:<br>CMMI® Requirements<br>Development and<br>Management in an Agile<br>Environment         |
|                      | Mrs. Kristin Kingland<br>Glowaski, Kingland<br>Systems Corporation   | Mr. Bradley Bittorf,<br>Raytheon Missile<br>Systems   | Mr. Kobi Vider, K.V.P<br>Consulting  | Mrs. Michele Moss, Booz<br>Allen Hamilton  | Mr. Ahmed Mahdy, Raya<br>Corporation  |

# **THURSDAY, NOVEMBER 18, 2010**

|                        | Track 1  | Track 2  | Track 3   | Track 4   | Track 5   |
|------------------------|--|--|---|---|---|
|                        | Chasm Creek  | Wind Star  | Mesa Verde  | Highlands   | Wind River  |
|                        | CMMI® and Process<br>Improvement   | Practical Guidance   | Performance Results   | Acquisition   | CMMI® and<br>Agile/Lean   |
|                        | Session Chairs:<br>Ms. Susan Bassham,<br>U.S. Army   | Session Chairs:<br>Mr. Geoff Draper, Harris<br>Corporation, Ms. Diane<br>Mizukami Williams,<br>Northrop Grumman<br>Corporation | Session Chair: Mr. Dennis Goldenson, Software Engineering Institute, Mr. Ken Weinberg, Raytheon Company | Session Chairs:<br>Ms. Lorraine Adams,<br>Software Engineering<br>Institute & Mr. Mike<br>Phillips, Software<br>Engineering Institute | Session Chair: Mr. Ken Nidiffer, Software Engineering Institute, Mr. Charles Ryan, Software Engineering Instititute   |
| 8:00 am -<br>8:45 am   | 10987 - Applying<br>CMMI®—SVC to<br>Process Management   | 11285 - Deployment<br>of Measurement and<br>Analysis at a Large<br>Multisite Company   | 11292 - The Issue of<br>Performance—Why Do You<br>Need a Maturity Level 5                               | 10942 - How Can I<br>Establish a Process<br>Architecture and Use it<br>Effectively?   | 11213 - Using the Agile<br>Methodology to Mitigate<br>the Risks of Highly<br>Adaptive Projects                        |
|                        | Ms. Dorna Witkowski,<br>Lockheed Martin<br>Corporation   | Mr. William Golaz,<br>Lockheed Martin<br>Corporation   | Mr. Kobi Vider, K.V.P<br>Consulting   | Dr. Gary Palosaari, The<br>Boeing Company   | Mrs. Dana Roberson,<br>Transdyne Corporation  |
| 8:45 am -<br>9:30 am   | 11141 - Improving<br>Operational Resilence<br>Processes  | 11273 - Divide and<br>Conquer—Marshaling<br>the "Masses" to Tackle<br>CMMI®  | 11310 - Performance<br>Effects of Measurement<br>and Analysis   | How MBE can<br>support Requirements<br>Development and<br>Technical Solution  | 11163 - Some Assembly<br>Required: Using Agile<br>Methodologies to Develop<br>an Interactive Software<br>User's Guide |
|                        | Mr. Richard Barbour,<br>Software Engineering<br>Institute  | Mr. Robert Tuthill,<br>Northrop Grumman<br>Corporation   | Dr. Dennis Goldenson,<br>Software Engineering<br>Institute  | Mr. Frank Salvatore,<br>High Performance<br>Technologies, Inc.  | Mr. Ronald Stauffer,<br>Raytheon Company  |
|                        |  | Break in Atriu   | m Display Area, 2 <sup>nd</sup> Flo   | oor   |   |
|                        | CMMI® and Process<br>Improvement   | Practical Guidance   | Performance Results   | Acquisition   | CMMI® and<br>Agile/Lean   |
|                        | Session Chairs: Mr. Jack Ferguson, Software Engineering Institute & Ms. Susan Bassham, U.S. Army | Session Chairs:<br>Mr. Geoff Draper, Harris<br>Corporation   | Session Chair: Mr. Dennis Goldenson, Software Engineering Institute, Mr. Ken Weinberg, Raytheon Company | Session Chairs: Ms. Lorraine Adams, Software Engineering Institute & Mr. Mike Phillips, Software Engineering Institute                | Session Chair:<br>Mr. Ken Nidiffer,<br>Software Engineering<br>Institute  |
| 10:00 am -<br>10:45 am | 10701 - Making<br>Process Deployment and<br>Monitoring Work                                      |  | 11312 - Implementing<br>High Maturity—A<br>Behavior Based Approach                                      | 11165 - A Streamlined<br>Approach to SW<br>Estimating Using Cocomo<br>II  | 11323 - Lean<br>Development—<br>Influencing the<br>Organization   |
|                        | Ms. Susan Byrnes,<br>Natural SPI, Inc.   |  | Mr. William Crowder,<br>Lockheed Martin<br>Corporation  | Mr. John Rossi, Rockwell<br>Collins   | Mr. Carl Gaul, The Boeing<br>Company  |
| 10:45 am -<br>11:30 am | 11319 - Proactive<br>Process Deployment is<br>Key to Institutionalization                        |  | 11177 - Connecting the<br>Dots: QPM, OPP, CAR,<br>and OID   | 10599 - Systems Engineering Processes Improvement Using the CMMI® in Large System of Systems Space Programs                           | 11324 - Lean<br>Development—Selecting<br>the Right Tools for<br>Maximum Success                                       |
|                        | Ms. Pamela Hudson,<br>Lockheed Martin<br>Corporation   |  | Ms. Diane Mizukami-<br>Williams, Northrop<br>Grumman Corporation  | Mrs. Sarit Assaraf, Israel<br>Aerospace Industries  | Mr. Carl Gaul, The Boeing<br>Company  |

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### CMMI® TECHNOLOGY CONFERENCE AND USER GROUP ➤ HYATT REGENCY TECH CENTER **DENVER, COLORADO** ► **NOVEMBER 15 - 18, 2010**

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### BY COMPLETING THE FOLLOWING, YOU HELP US UNDERSTAND WHO IS ATTENDING OUR EVENTS.

### PRIMARY OCCUPATIONAL **CLASSIFICATION.** Check ONE.

- Defense Business/Industry
- R&D/Laboratories
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- ➢ General/Admiral
- Colonel/Navy Captain
- Lieutenant Colonel/Commander/ Major/Lieutenant Commander
- Captain/Lieutenant/Ensign
- Enlisted Military
- Other \_

| Year of b  | irth |  |  |
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| (optional) |      |  |  |

#### **QUESTIONS, CONTACT:**

**KELLY SEYMOUR, MEETING PLANNER** 

**PHONE:** (703) 247-2583

**E-MAIL:** KSEYMOUR@NDIA.ORG

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# CMMI® TECHNOLOGY CONFERENCE AND USER GROUP

Investigation, Measures and Lessons Learned About the Relationship Between CMMI® Process Capability and Project or Program Performance

NOVEMBER 15 -18, 2010 HYATT REGENCY DENVER TECH CENTER DENVER, COLORADO

# **Process Deployment and Monitoring**









# **Topics**

| 3  | Purpose                                 |
|----|---|
| 4  | A Closer Look at OPF SG3                |
| 11 | Common Pitfalls                         |
| 17 | Strategic and Tactical Deployment Plans |
| 22 | Evaluating Process Deployment           |
| 26 | Summary                                 |



# **Purpose**

This presentation proposes an approach for supporting successful deployment and monitoring of process improvements.



# Where in the life cycle are we?





### A closer look at OPF SG 3

Organizational Process Focus (OPF) Specific Goal 3 (SG3) Deploy Organizational Process Assets and Incorporate Lessons Learned

□ The organizational process assets are deployed across the organization and process-related experiences are incorporated into the organizational process assets.

What does "Deployed" mean in your organization?

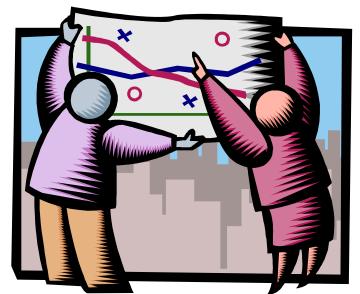


# What does this mean?<sub>1</sub>

# OPF SP 3.1 Deploy Organizational Process Assets

Deploy organizational process assets across the organization.

OPF SP 3.1 is about identifying the strategy (and the necessary support resources) for deploying new and changed assets to the entire organization.



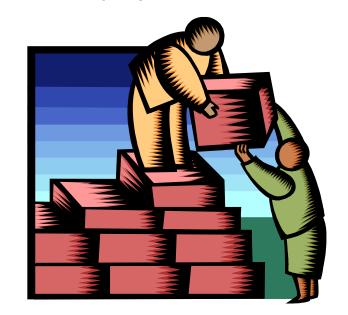


# What does this mean?<sub>2</sub>

# **OPF SP 3.2 Deploy Standard Processes**

 Deploy the organization's set of standard processes to projects at their startup and deploy changes to them as appropriate throughout the life of each project

OPF SP3.2 is about helping individual projects adopt and tailor current organizational processes





# What does this mean?<sub>3</sub>

# **OPF SP 3.3 Monitor Implementation**

Monitor the implementation of the organization's set of standard processes and use of process assets on all projects.



If you don't have a plan, what are you monitoring against?





# What does this mean?<sub>4</sub>

OPF SP 3.4 Incorporate Process-Related Experiences into the Organizational Process Assets

Incorporate process-related work products, measures, and improvement information derived from planning and performing the process into the organizational process assets.

This includes capturing experiences related to deploying processes!



# Who is responsible for process adoption?

Process deployment and monitoring is an organizational activity:

- Projects are responsible for using current processes, but the process focus group is responsible for making sure projects can succeed in this endeavor
- Monitoring of process deployment needs to occur at an organizational level, projects have lots of other things to worry about





# **Common Deployment Pitfalls**

- Assuming training ensures adoption
- □ Interacting only with "process-friendly" people when deploying
- Discouraging feedback during deployment
- Assuming that no feedback = adoption
- Mandating immediate adoption of process changes (without consideration to rework or other project impacts)
- Assuming when people don't perform the process, they are wrong and the process definition is right
- Assuming a deployment plan is not necessary

So how do I avoid the pitfalls?



# **Avoiding the Pitfalls**

- Evaluate which projects should adopt the change and when
- Evaluate how difficult deploying the change will be
- Develop a strategic deployment plan conveying in a few bullets how the deployment will be accomplished
- Develop a detailed tactical plan for ensuring all projects that should adopt the change actually do
- Monitor the deployment until adoption is achieved



# Which projects should adopt the change and when?

### There are several considerations:

- Minimizing impact to active projects
- Urgency of adoption of this process change
- Minimizing length of process deployment and monitoring
- Minimizing different process versions in use at one time

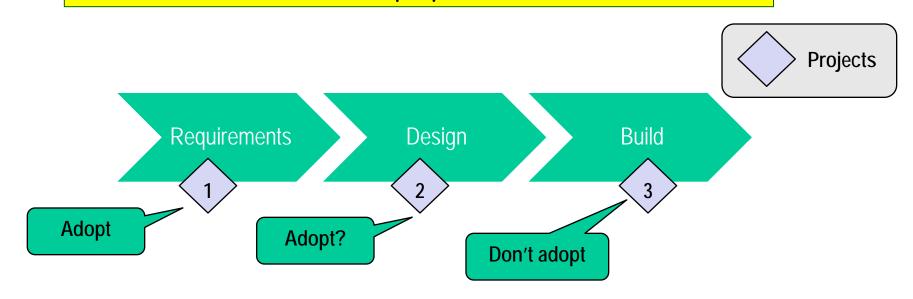
### There are also several options:

- □ All projects adopt immediately
- All new projects adopt at start-up
- All projects that have not yet reached a certain life cycle phase
- All projects for a particular customer or product
- □ All projects using a certain life cycle



# **Process Adoption Considerations- Example #1**

Example: New Design Document Template to be deployed

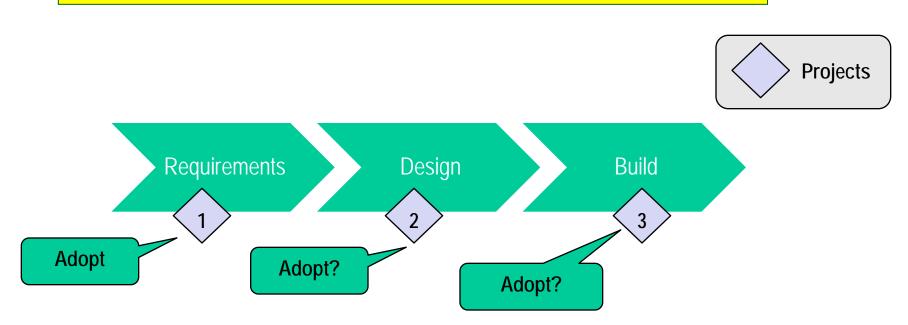


Certainly all new projects should adopt current processes, but what about active projects?



# **Process Adoption Considerations- Example #2**

Example: Status Report Format Change to be deployed



Certainly all new projects should adopt current processes, but what about active projects?



# How hard will it be to deploy this change?

### There are several considerations:

- How much impact will the change have?
- Do we anticipate resistance for some reason?
- What is the consequence of the change not being adopted?

### There are also several options:

- PPQA auditing (process or work product) may be sufficient (all projects or sampled)
- Class room training (with or without exercises)
- One-on-one mentoring
- Feedback collection at point of implementation
- Pilot before deploying



# **Strategic Plan**

Before getting into the details, develop a strategy, for example:

# Example

- Our goal is for all new projects starting after October 1 to adopt the new process
- We plan to retire the current process by May of next year
- □ Projects will receive training on the new process at project start-up – annual refresher training will include an overview of the new process
- We will monitor adoption by:
  - Conducting lessons learned specific to this process
  - Auditing all projects for the first year



### Tactical Plan – Overview

Process deployment also requires a tactical plan:

- Develop an integrated schedule that ties the process deployment to each affected project's life cycle
- Identify resources needed (facilities, people, materials)
- □ Schedule training, PPQA audits, other deployment support
- Schedule monitoring (evaluation of results)
  - Review PPQA results
  - Review training feedback
  - Review lessons learned



For some changes, we'll need a way to determine whether to stop and re-start the deployment



### **Tactical Plan - Measures**

Establish measures for determining when you're done:

- When do we expect all projects to be using the new process?
- □ How long do we have to keep monitoring?
  - Monitor first "n" uses of the process?
  - Monitor through a certain date?
- □ How will we determine success of the deployment?
  - Satisfactory PPQA results?
  - % training attendance by teams?
  - Minimum survey results on deployment?
  - Feedback on deployed process (# of change requests or tailoring requests)?



# Deploying processes at project startup

Project start-up should include providing guidance on defining and implementing the project's defined process:

- Provide a reminder of recent process changes
- Check that everyone is trained on recent process changes
- Check for new team members and people who have changed roles
- □ If this will be one of the monitored projects, remind the team of this

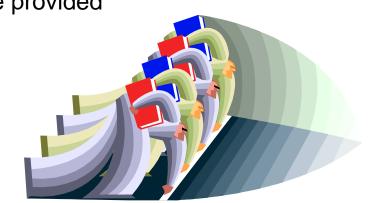
Process deployment needs to consider impacts on the project start-up process



# Ready, Set, Go!

### Make sure you are ready to deploy:

- Assets are in the PAL
- Tailoring criteria is defined
- Communicate:
  - Who must comply and by when
  - □ What training will be provided and when
  - What additional assistance will be provided
  - Why the change is being made
- Training scheduled
- PPQA audits scheduled
- Support resources secured





#### What will monitoring tell us?

## Training Results

- Was attendance adequate?
- Were training materials adequate?
- Additional or different training needed?

#### PPQA Audit Results

- Do audit results reflect adoption?
- Is audit efficient or overly time consuming?

#### Lessons Learned

- Are changes to the process needed?
- Have future improvements been identified?

#### **Validation**

 Does process change achieve business objective?

# Was deployment successful?



#### How will I know the deployment worked?

Ultimately, successful adoption means:

- PPQA audits indicate the process is being followed
- Lessons Learned indicate use of the process and identification of potential improvements rather than problems
- Evidence of process use (measures, work products, tailoring requests) are being collected
- □ Feedback on the defined processes and assets is used to improve them



#### What happens once the process is adopted?

- Training on the new process remains part of overall training
- PPQA audits continue to be performed (but possibly on smaller sampling of projects)
- Process improvements to training materials, PPQA assets, deployed assets, and deployment processes are captured
- Adoption measures are captured



#### **Evaluating the deployment process**

Evaluate and measure the deployment process:

- Surveys or lessons learned sessions with teams involved in the deployment
- Elapsed time to adoption versus size of change
- % of projects that used support
- # of deployment re-starts



#### **Summary**

Deployment planning can mean the difference between project deployment success and failure:

- □ Planning may take some time for the deployment team, but will save time for all impacted projects during deployment
- □ Projects plan and manage their work the deployment team should do the same!

Take ownership for successful deployment!



#### **Questions**





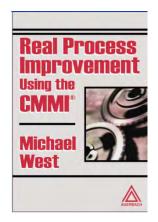
#### **Contacts and More Information**

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Natural SPI's web site: www.naturalspi.com







## Applying CMMI-SVC to Process Management



Allen Eagles
Lynn Penn
Dorna Witkowski

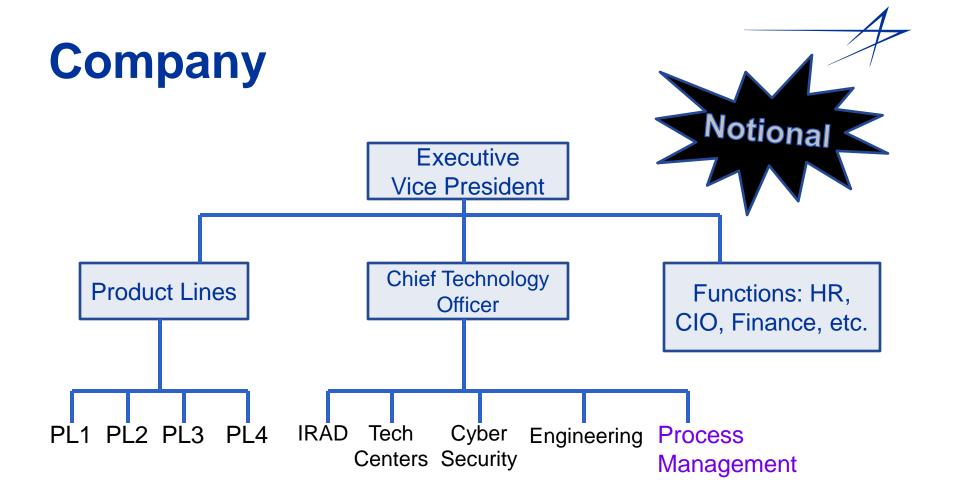
#### **Agenda**

1

- Process Management introduction
- Planning
- Implementation
- Results
- Plans ahead

#### **Process Management**

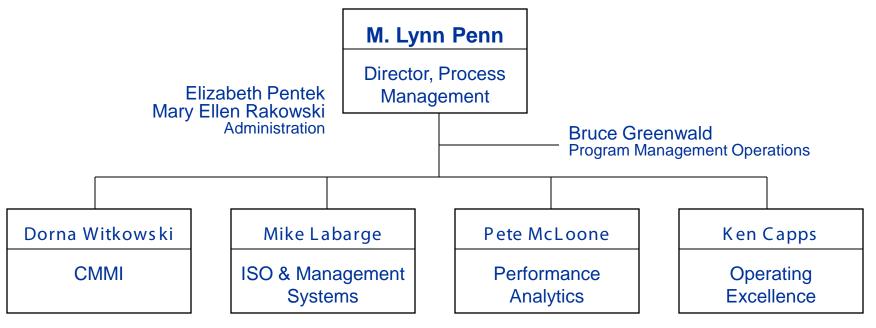
- Reports to the CTO/Engineering & Technology
- Responsible for:
  - Standards and model assessment, internal and external
    - CMMI, ISO, AS9100
    - Tools to support assessments: Common Audit Database, Program Profile Database, etc.
  - Best Practice Libraries, R&D process support, process collaboration with Product Lines, Policy board chair and facilitation
  - Performance Analytics tools and metrics
  - Lean/Six Sigma Operating Excellence
- Reorganized in 2010 to be more service and project focused





#### **Process Management Organization**

July 26, 2010





#### Staff

- Dottie Acton\*
- Mary Busby
- Jennifer Curtis
- Allen Eagles
- Gary English
- Paul Gehman
- Barbara GeshwindBob Yates
- Marc Gewertz

- Greg Kerchner
- Len Mikolajczak
- Nicole Tucker\*
- Dick Warren
- Suzanne Weisenberger
- Joan Weszka

IS&GS Engineering & Technology



## **Process Management Service Initiatives**

#### • CMMI:

- Provide training, consulting, SCAMPI B/C preparation and execution, SCAMPI A preparation and support
- ISO and Management Systems:
  - Provide training, consulting, internal auditing, process monitoring, supervision of ISO and AS9100 audits
- Performance Analytics
  - Establish baselines; perform benchmarking, monitoring, control, cost and schedule modeling, affordability and productivity, basis of estimates, predictive analytics
- Operating Excellence Lean/Six Sigma:
  - Provide Lean/Six Sigma training, event facilitation, process improvement reporting, Product Line process improvement facilitation

In 2010 each initiative was required to create a project plan, a schedule, and a service catalog

#### Why use CMMI-SVC



- To provide better service to our internal customers
- To become more disciplined
- To establish continuity
- To conform to what we expect from our programs
- To expand knowledge of problems and issues we might face from practitioners



## **Quick Overview of CMMI-SVC Specific Process Areas**

- Service Delivery (SD) Deliver services in accordance with service agreements
- Capacity and Availability Management (CAM) Ensure effective service system
  performance and ensure that resources are provided and used effectively to support
  service requirements
- Incident Resolution and Prevention (IRP) Ensure timely and effective resolution of service incidents and prevention of service incidents as appropriate
- Service System Transition (SST) Deploy new or significantly changed service system components while managing their effect on ongoing service delivery
- Service Continuity (SCON) Establish and Maintain plans to ensure continuity of services during and following any significant disruption of normal operations
- Service System Development (SSD) Analyze, design, develop, integrate, verify and validate service systems, including service system components, to satisfy existing or anticipated service agreements
- Strategic Service Management (STSM) Establish and maintain standard services in concert with strategic needs and plans



## Planning the CMMI-SVC Gap Analysis

- Scope:
  - Within Process Management only our 4 major initiatives and management
    - Did not cover tools and other services
  - Within the model only looked at the specific practices of the Service PAs
    - Including the addition, Service System Development

## 1

## Planning the CMMI-SVC Gap Analysis

- Sequence of Process Areas to review:
  - Phase 1: Service Delivery, Incident Resolution (and Prevention), Service Continuity
    - We focused on process areas where evidence was available
  - Phase 2: Service System Development, Strategic Service Management
    - As the year progressed, there was time to show evidence of strategy and development of new or modified services
  - Phase 3: Capacity and Availability Management,
     Incident (Resolution and) Prevention, Service
     System Transition
    - Most challenging for a small service group



## Planning the CMMI-SVC Gap Analysis

- Method work product focus
  - Study the CMMI-SVC Process Area
  - Consider Specific Practice Work Products in the model
  - Look at Process Management Work Products
    - That will meet the intent
  - Interview Project Leads to identify gaps
  - Map the collected data to the Specific Practices
  - Publish the gap analysis, assign actions and work to closure
  - Track completion of action plans

## 1

#### Implementation of the Plan

Sample interpretation of work products and gap analysis

## Service Delivery SP 2.1 Establish the Service Delivery Approach

#### Model has example work products:

- Service delivery approach
- Contact and roster lists
- Service request criteria
- Internal and external status reporting

## Initially, looked for *Process Management work* products:

- Documented service approach
- Contact and team member lists
- Customer and senior management status reports



#### Implementation of the Plan

Sample interpretation (continued)

#### Actual work products found:

- Service delivery approach provided in project plan
   Service Delivery sample from Project Plan: Product Lines, Programs, or Senior
  - Management may request the services identified in the Service Catalog. The CMMI project will provide staffing for the requested service and establish an agreement with the requester with respect to funding, timeframe of the service, work products to be provided with the service, and expectation of the results of the service.
- Contact list; Team member list
- Internal status reports

## 1

#### Implementation:

- Along the way, we met some resistance...
  - Critical milestones such as ISO Audits, Executive Directives, and Corporate Milestones interfered with implementation
    - "Don't bother me I'm too busy with this ISO Audit."
  - Limited staff delayed resolution of actions
    - "I don't have time to do this, one of my 2 staff members was reassigned and I'm behind in my schedule."
    - "With only 2 and ½ people I don't think my project meets the definition of a service as referenced in the model!"
  - Perceptions
    - "I don't need to test continuity, I have everything on our web site."

Now we're prepared for programs!!

## 1

## Implementation: ...and acceptance

- Showed project leaders why certain activities identified in the service-specific process areas can actually benefit them, their project, and their customers
  - Examples:
    - Tested continuity plans, with reported results
    - Incidents tracked and workarounds determined; future analysis planned
    - Guidebook on developing / revising a service



- Interpretation of the model
  - Implementing the model didn't require fancy tools, spreadsheets, etc.
  - We held a brainstorming session to define "Incidents" for our service initiatives
- Methodology
  - We adjusted our methodology along the way
    - Changed planned sequence of PAs after phase 1
    - In later phases, spent more time on pre-interview discovery to look for evidence already available
    - Adjusted methods when we found true systemic gaps for SSD and IRP



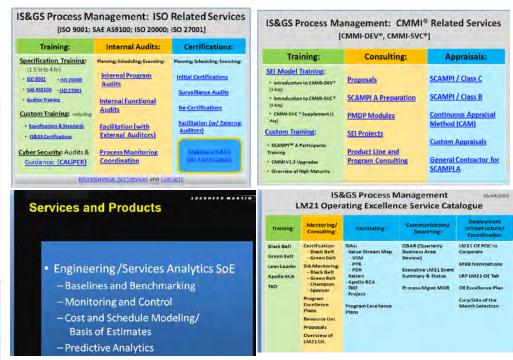
- Gap Analysis systemic problems
  - No documented approach to developing a new service
  - No documented continuity plans
  - Incidents not defined
  - Incident tracking not defined
  - No formal service level agreements to set expectations



 Developed and published service catalogs for each project area and the other services we offer

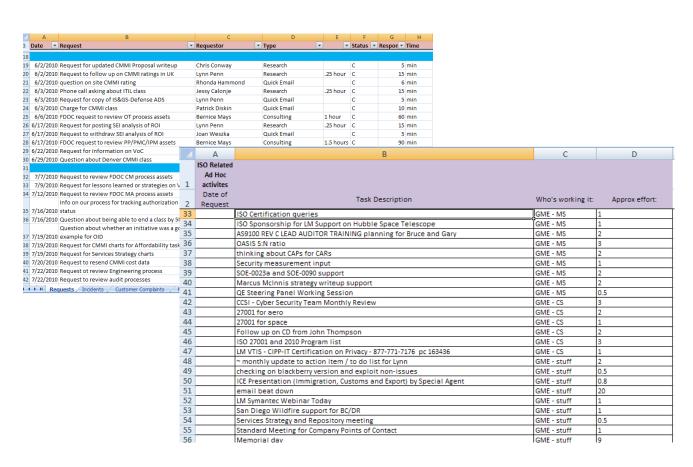








#### Established incident and request logs





#### Established continuity plans and tested the plan

#### Service Continuity Plan for CMMI Project

The essential functions of the CMMI Project include performing as team m as planning and performing SCAMPI/Class B's and C's. These are the functious tower's schedules and may impact their business goals.

The essential resources of the CMMI Project are the staff performing the e tools they use in performing these functions.

All pertinent files and information will be stored on the Process Managem folder

- Exceptions are Risk Management files and MOR files which are sto Management Unity site in other standard folders.
- This should include all work-in-progress files for planned work
- Unity sites are backed up on a daily basis by Enterprise Business Sy

The CMMI Project Lead's back-up is the Director, Process Management.

 On a periodic basis, the CMMI Project Lead will ensure the Directo knows of all current activity. This can be done at weekly face-to-fa Monthly Operating Reviews, and through emails.

The back-up for CMMI Project staff doing planned projects for the CMMI P Lead.

 On a periodic basis (nominally weekly), CMMI Project staff will ens Lead knows the status of all activity, as well as points of contact fo Service Continuity Test - March 2010

#### Test #1: CMMI Project Lead Backup

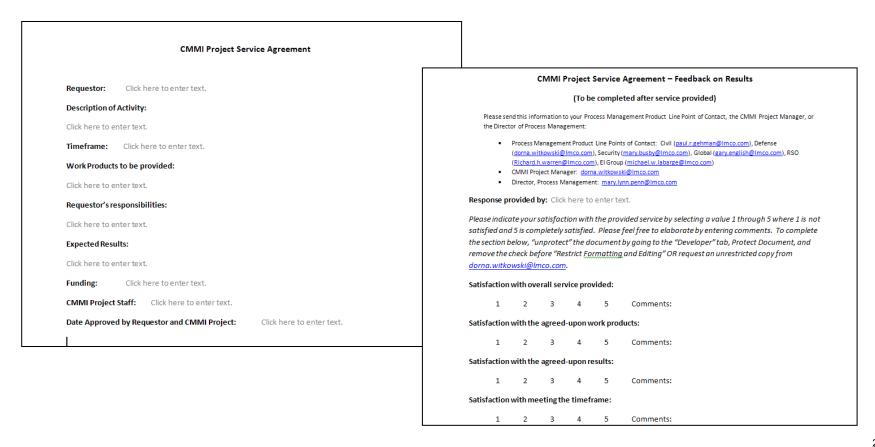
Test conducted 3/7/10 - 3/11/10; black text is the test from the Service Continuity Plan; Aqua text is the result of the test.

#### Preparation:

- Identify 2 customers to participate in test
  - o Marcia Miller and Lloyd Brown from IS&GS-Defense supported the test
- · Identify 1 internal CMMI staff member to participate in test
  - o Barbara Geshwind supported the test
- Tell Director, Process Management of test to be done
  - o Director, Process Management was told the week before the test that it would be done
- CMMI Project Lead sets Out of Office message to have customers contact Director, Process Management for CMMI questions or activities
  - o Out of office message set on Email and Voice Mail
- Contact customers and request that they email or call with questions on CMMI
  - o Customers contacted
- Contact internal CMMI Staff member and request that he/she email or call with question on tasks
  - Internal staff member contacted



## Established service agreements and received feedback from customers





#### • Also:

- Wrote guidance for developing services
- Working on a service strategy for our entire business area
  - A service sample repository
  - Maps of service components to models and standards

## 1

#### What was easy to implement

- SD Service Delivery
  - Providing our services in a more professional and organized manner
- The IR of IRP Incident Resolution
  - Identifying and resolving incidents
- SCON Service Continuity
  - Establishing and testing continuity plans
- SST Service System Transition
  - Providing a new service in an orderly, controlled manner

#### What was easy to implement (cont.)

- cont.)
- STSM Strategic Service Management
  - Establishing plans, service catalogs and levels of service
- SSD Service System Development
  - Although we didn't have anything documented initially, following a standard method of developing new or modified services will provide a more disciplined and thorough method that we can easily follow

## 1

#### What is hard to implement

- CAM Capacity and Availability Management
  - Although we know and can manage our capacity and availability, a "Service System Representation" is very difficult for a small people-related organization
- The P of IRP Incident Prevention
  - Because incidents are rare and there is usually no commonality between them, it is difficult to establish prevention mechanisms

#### **Plans**



- Expand to Core Process Areas in 2011
- No plans for a SCAMPI B/C at this time as we are still working to close gaps
- Use the experience gained for future adoption across the business area

#### **Questions**





**Improving Operational Resilience Processes** 

**CERT Resilience Management Model (RMM)** 

10<sup>th</sup> Annual CMMI Technology Conference and User Group

Rick Barbour & Rich Caralli
CERT
Software Engineering Institute



#### **Agenda**

- What is CERT®-RMM?
- > Risk, Resilience & Convergence
- Overlap between CERT-RMM & CMMI process areas
- CERT-RMM as an organizing principle
- CERT-RMM Current Activities

### What is CERT®-RMM?

The CERT® Resilience
Management Model (CERTRMM) is a capability model for
managing and improving
operational resilience.

- Positions operational resilience in a process improvement view
- Includes 26 "process areas"
- Focuses on the operations phase of the lifecycle
- Defines "maturity" through "capability levels" consistent with CMMI
- Uses CMMI architecture for ease of adoption
- Includes a "continuous representation" for agile adoption

### Distinguishing features of CERT®-RMM

CERT-RMM brings several innovative and advantageous concepts to the management of operational resilience.

- The convergence advantage: merging the disciplines of security, BC/DR, and IT ops into a single model
- The process advantage:
   elevating these disciplines to a
   process view, useful as an
   integration and measurement
   framework
- The maturity advantage:
   provides a foundation for practical
   institutionalization of practices—
   critical for retaining these
   practices under times of stress

### **CERT-RMM** background

CERT-RMM began as research into the application of process improvement and maturity model approaches to security management.

- Literary review and affinity analysis of over 800 standard practices security, BC/DR, and IT ops communities
- Examination of body of knowledge of high-maturity organizations
- Codification of model using trusted CMMI architecture and concepts
- Benchmarking and piloting in the banking/finance community, defense contractors, and US government federal civilian agencies

### **CERT-RMM** at a glance

Requirements Management

RRD – Resilience Requirements

**Development** 

RRM – Resilience Requirements

Management

Asset Management

ADM - Asset Definition and

Management

Establishing Resilience

SC - Service Continuity

CTRL - Controls Management

RTSE - Resilient Technical

Governance, Risk, & Compliance

Solution Engineering

Engineering Management

Operations Management

Enterprise Management Process Management Asset Resilience Management

EC – Environmental Control

KIM – Knowledge & Information

Management

PM – People Management

TM – Technology Management

Sourcing

EXD – External Dependencies

Threat, Incident, & Access Management

AM - Access Management

ID - Identity Management

IMC – Incident Management &

Control

VAR – Vulnerability Analysis &

Resolution

Data Collection & Logging

**MON – Monitoring** 

**Process Management** 

MA - Measurement and Analysis

OPD - Organizational Process

Definition

OPF – Organizational Process

**Focus** 

COMP – Compliance
EF – Enterprise Focus
RISK – Risk Management
Supporting Resilience
COMM – Communications
FRM – Financial Resource
Management
HRM – Human Resource
Management
OTA – Organizational Training &
Awareness

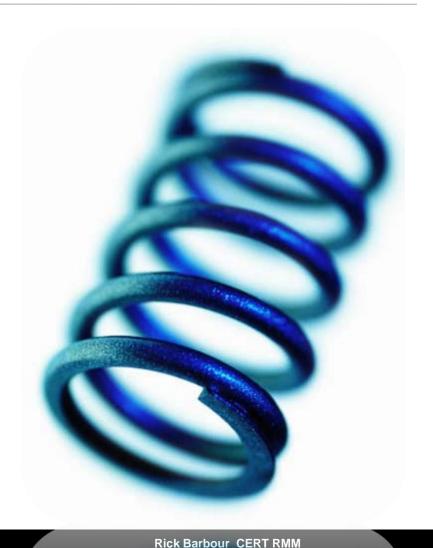




### **Operational resilience**

Resilience: The physical property of a material when it can return to its original shape or position after deformation that does not exceed its elastic limit [wordnet.princeton.edu]

Operational resilience: The emergent property of an organization exhibited when it continues to carry out its mission after disruption that does not push it beyond its operational limit



### Convergence

A fundamental concept in managing operational resilience

Refers to the harmonization of **operational risk management activities** that have similar objectives and outcomes

Operational risk management activities include

- Security planning and management
- Business continuity and disaster recovery
- IT operations and service delivery management

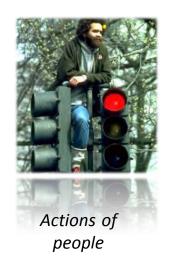
Other support activities may also be involved—communications, financial management, etc.

### Operational resilience & operational risk

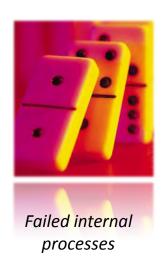
Security and business continuity are not end-states; they are continuous processes

Effective operational risk management requires harmonization: convergence of these activities working toward the same goals

Operational resilience emerges from effective operational risk management

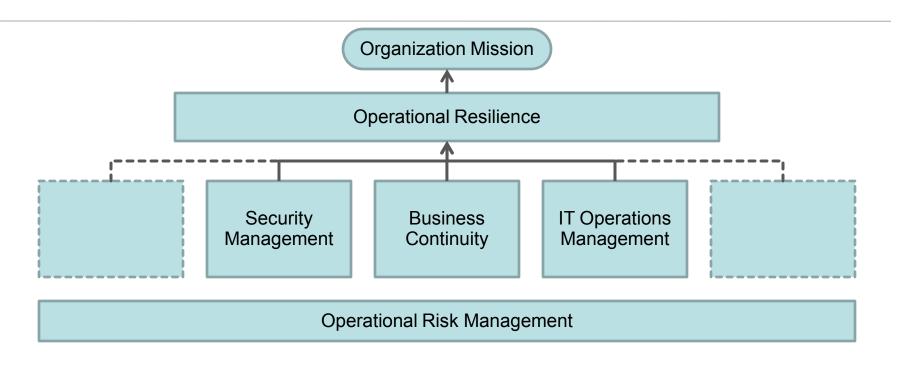








### Operational resilience and convergence



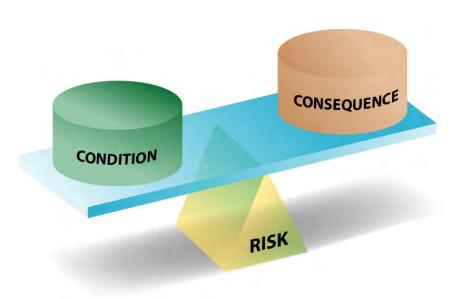
Convergence directly affects the level of operational resilience.

Level of operational resilience affects the ability to meet organizational mission.

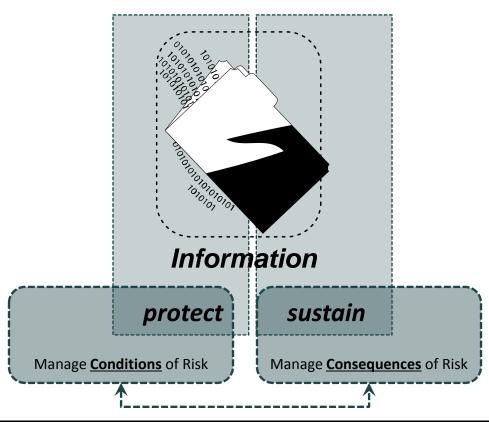
### Protection, sustainability, and risk

### **Basic risk equation**

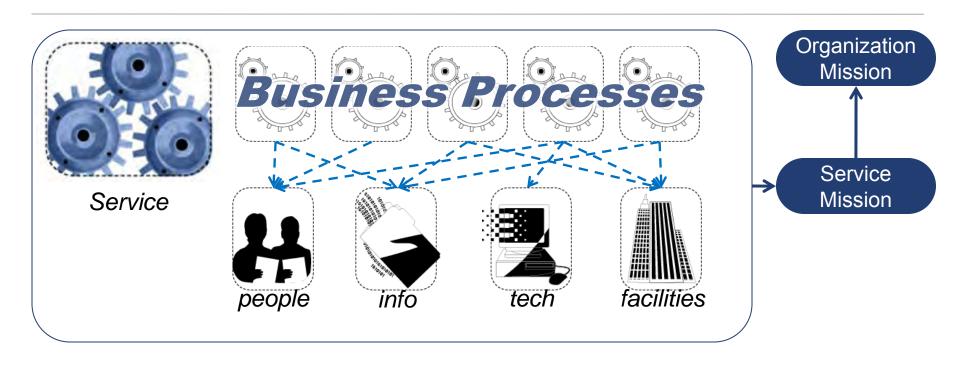
### **Protection & sustainability**



Operational resilience requires *optimizing* these strategies in a way that minimizes operational risk (to the associated services) and *is resource efficient:* the management challenge of operational resilience.

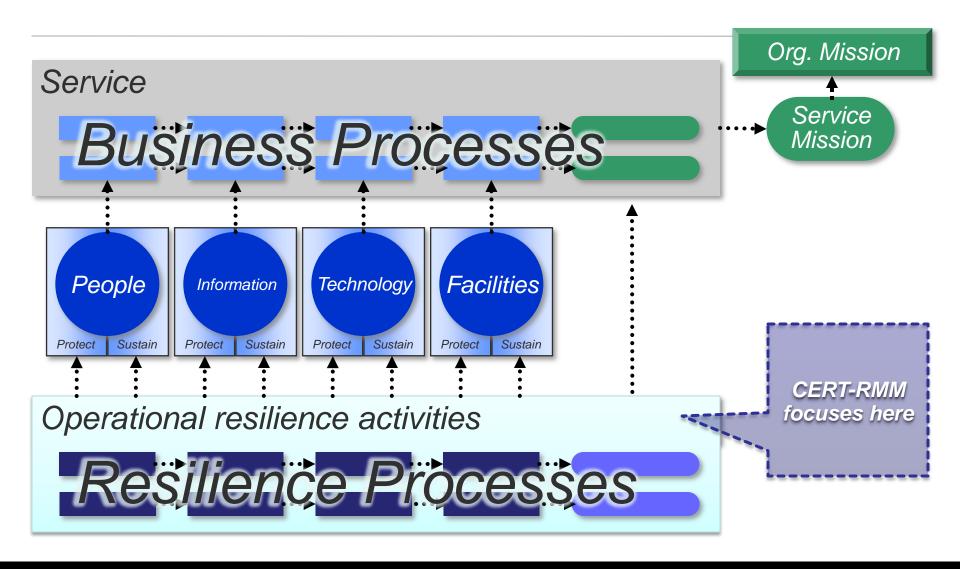


### A service view

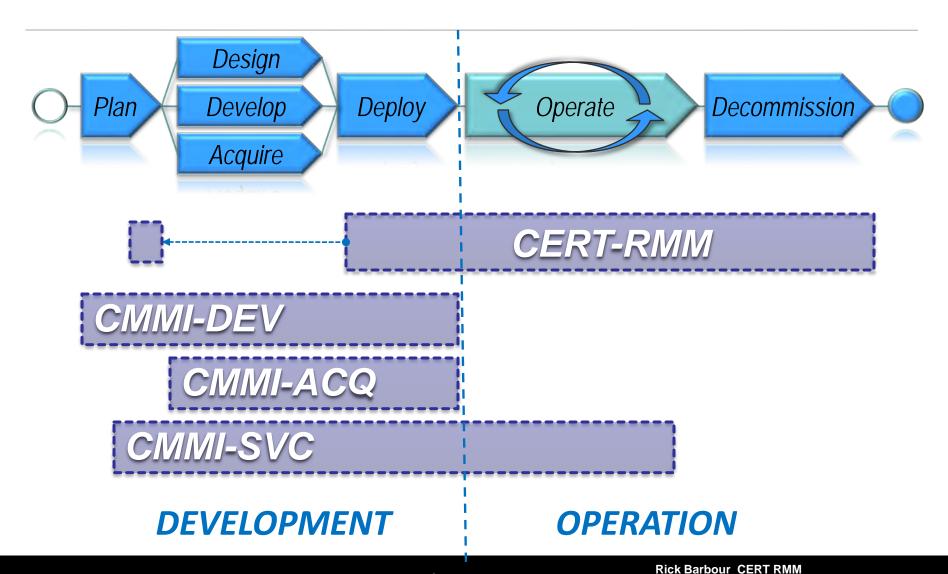


The organization meets its mission when high-value services in the organization meet their missions.

### The object of improvement



### **CERT-RMM** position in lifecycle





# Overlap between CERT-RMM & CMMI process areas-1

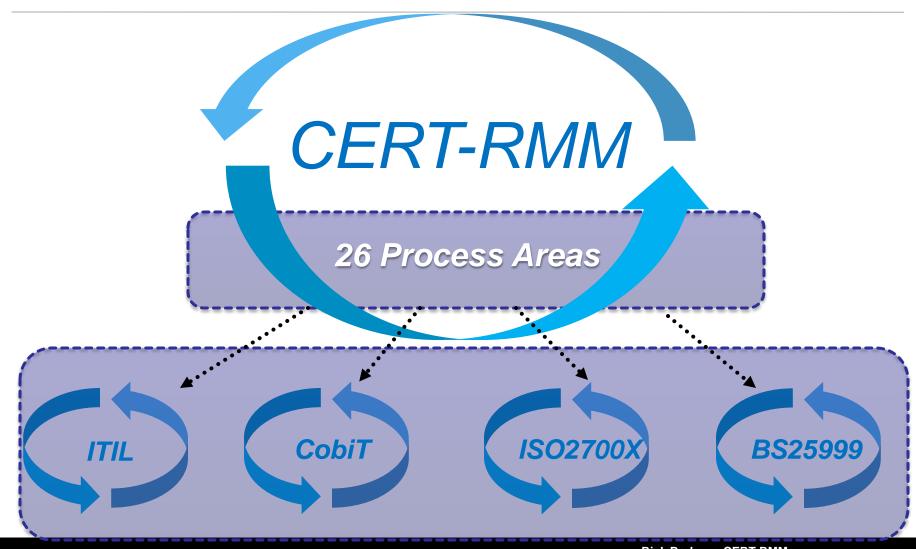
| CMMI Models Process Areas                                  | <b>Equivalent CERT-RMM Process Areas</b>   |  |  |  |
|--|--|--|--|--|
| CAM – Capacity and Availability Management (CMMI-SVC only) | <b>TM – Technology Management</b> Availability management is a central theme of CERT-RMM this includes PAs: RRD, RRM, EC, KIM, PM, TM  |  |  |  |
| IRP – Incident Resolution and Prevention (CMMI-SVC only)   | IMC – Incident Management and Control  |  |  |  |
| MA – Measurement and Analysis                              | MA – Measurement and Analysis is carried over intact from CMMI.  |  |  |  |
| OPD – Organizational Process Definition                    | OPD – Organizational Process Definition is carried over from CMMI, but development life-cycle-related activities and examples are deemphasized or eliminated.  |  |  |  |
| OPF – Organizational Process Focus                         | OPF – Organizational Process Focus is carried over intact from CMMI.   |  |  |  |
| OT – Organizational Training                               | OTA – Organizational Training and Awareness OT is expanded to include awareness activities in OTA.   |  |  |  |
| REQM – Requirements Management                             | RRM – Resilience Requirements Management  Basic elements of REQM are included in RRM, but the focus is on managing the resilience requirements for assets and services, regardless of where they are in their development cycle. |  |  |  |
| RD – Requirements Development                              | RRD – Resilience Requirements Development  Basic elements of RD are included in RRM, but practices differ substantially.   |  |  |  |

# Overlap between CERT-RMM & CMMI process areas-2 and Other Connections

| CMMI Models Process Areas                        | Equivalent CERT-RMM Process Areas   |
|--|---|
| RSKM – Risk Management                           | RISK – Risk Management  Basic elements of RSKM are reflected in RRM, but the focus is on operational risk management activities and the enterprise risk management capabilities of the organization.  |
| SAM – Supplier Agreement Management              | EXD – External Dependencies Management In CERT-RMM, SAM is expanded to address all external dependencies, not only suppliers. EXD practices differ substantially.   |
| SCON – Service Continuity<br>(CMMI-SVC only)     | SC – Service Continuity  In CERT-RMM, SC is positioned as an operational risk management activity that addresses what is required to sustain assets and services balanced with preventive controls and strategies (as defined in CTRL – Controls Management). |
| TS – Technical Solution                          | RTSE – Resilient Technical Solution Engineering RTSE uses TS as the basis for conveying the consideration of resilience attributes as part of the technical solution.   |
| Other Conncections:  Generic goals and practices | The generic goals and practices have been adapted mostly intact from CMMI.  |
| Other Connections:  Continuous representation    | CERT-RMM adopts the continuous representation concept from CMMI intact.   |



### Example: CERT-RMM as an organizing principle



### **Current Approaches to Security Management**

### Security by compliance

- •FISMA
- •HIPAA
- •PCI

Security by adoption of **best practices** 

- •ISO 17799
- DISA STIGs
- Vendor guides













Result:

Uneven use of limited resources



### Relationship to NIST Guidance

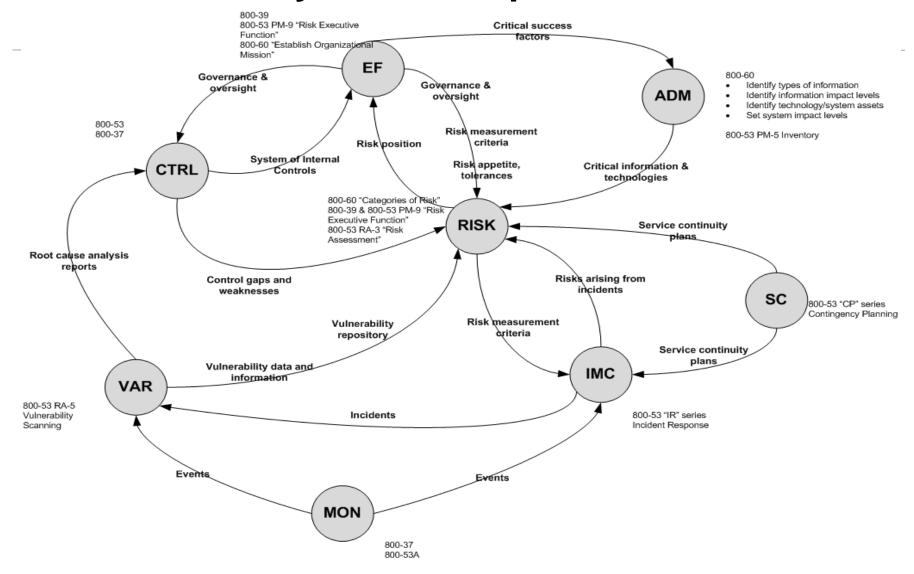
### NIST provides guidance

- Risk Management Framework addresses controls management (800-37, 800-53, et. al.)
- Risk Hierarchy forms the basis for an enterprise risk management program (800-39)
- RMM maps to a risk ecosystem to actualize and extend the NIST guidance

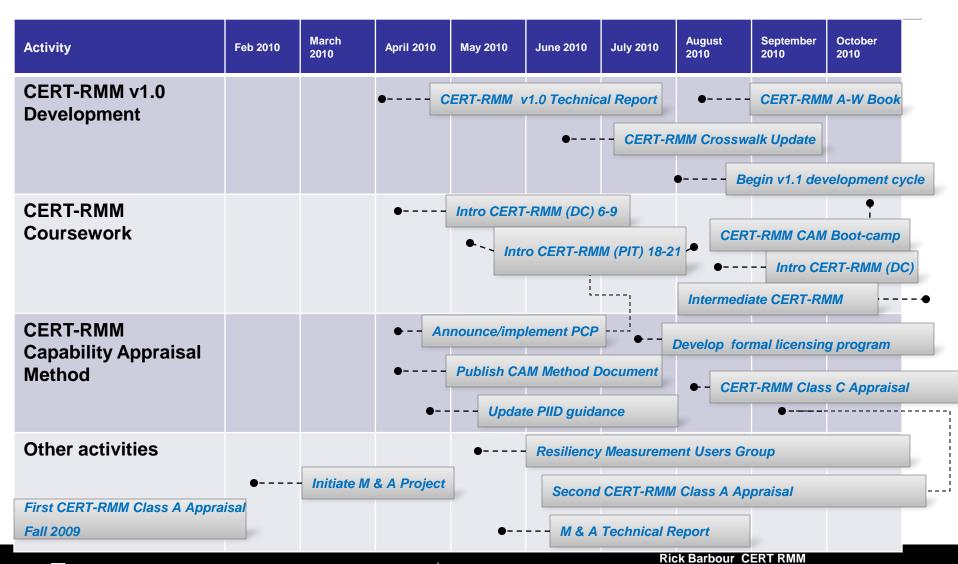




### RMM Risk Ecosystem example



### **CERT-RMM Current Activities**





### **Questions??**

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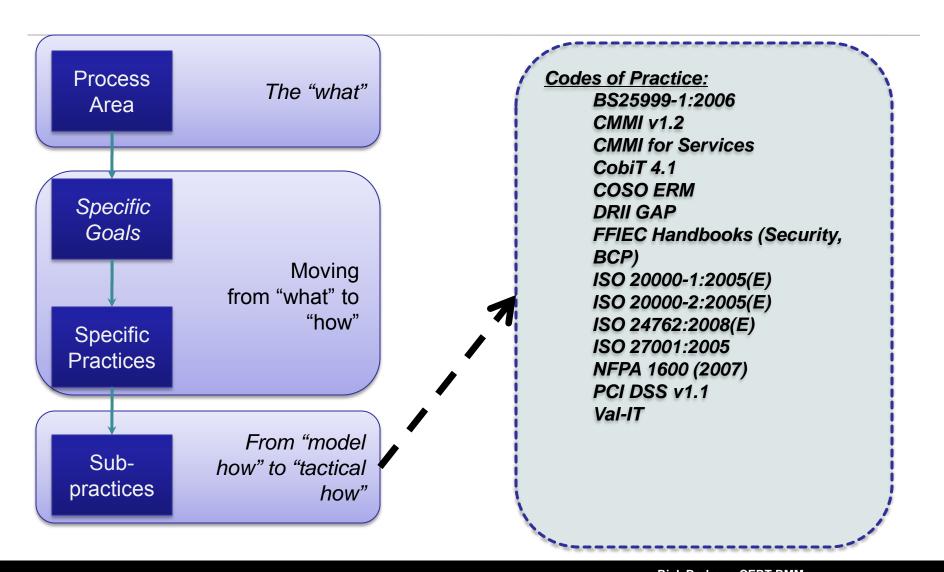
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## Back-ups

### **CERT-RMM** links to codes of practice



### GAO-09-835T report says:

An underlying reason for the apparent dichotomy of increased compliance with security requirements and continued deficiencies in security controls is that the metrics defined by OMB and used for annual information security reporting do not generally measure the effectiveness of the controls and processes that are key to implementing an agency wide security program.

Results of our prior and ongoing work indicated that, for example, annual reporting did not always provide information on the quality or effectiveness of the processes agencies use to implement information security controls. Providing information on the effectiveness of controls and processes could further enhance the usefulness of the data for management and oversight of agency information security programs.

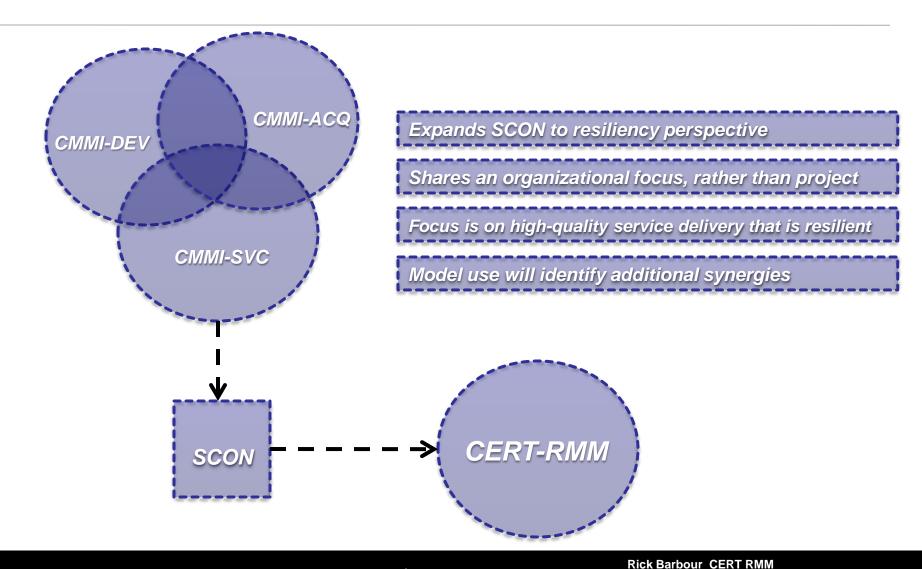
### **CERT-RMM** timeline

| 2003 | 2004       | 2005      | 2006      | 2007     | 2008      | 2009        | 2010       |
|------|------------|-----------|-----------|----------|-----------|-------------|------------|
| •[   | Rest-in-   | Class Op  | perations | Roundt   | ahle      |             |            |
| ı    |            |           |           |          |           |             | 0          |
|      | •          | recnnica  | i Report: | "Wanag   | ing for E | nterprise   | Security   |
|      |            | •         | Began c   | ollabora | tion with | <b>FSTC</b> |            |
|      |            | •         | Comme     | nced dev | velopmer  | nt of PRIS  | SM: Proce  |
|      |            | ,         | 7         | echnical | Report:   | "Sustain    | ing Oper   |
|      |            |           | •         | mproven  | nent App  | roach to    | Security   |
| CERT | T Resiliei | ncy Engil |           |          |           |             |            |
| CER  | T Resilie  | ncy Engl  | ineering  | Framewo  | ork v0.95 | benchm      | arking ef  |
|      | Intro t    | o CERT I  | Resilienc | y Engine | ering Fr  | amework     | course     |
|      |            | CE        | DT Pocili | ionco Ma | nadoma    | st-Model    | v0 95 rele |

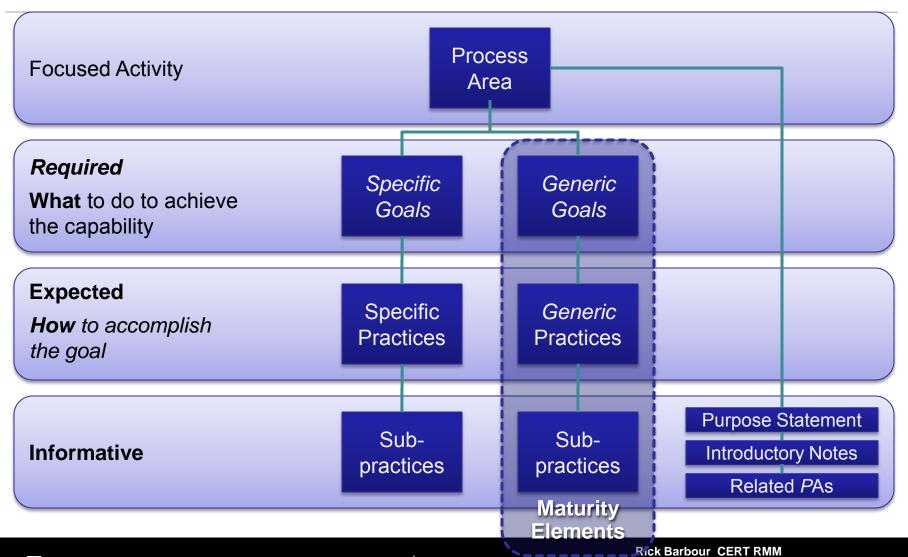


CERT Resilience Management Model v1.0

### **CERT-RMM and CMMI-SVC**



### **CERT-RMM** process area structure





### **CERT-RMM Product Suite**

Model artifacts available to begin an adoption process

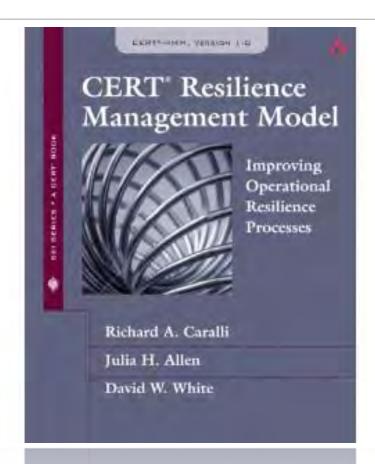
### **CERT-RMM** product suite

| Product                                   | Status  |
|---|---|
| CERT-RMM Model                            | Version 1.0 released; Technical Report released; individual process areas released @ www.cert.org/resilience  |
| CERT-RMM Capability Appraisal Methodology | Version 1.0 to be released in method description document, August 2010  |
| CERT-RMM Crosswalk                        | Version 0.95 published; Version 1.0 (expanded) to be published late Summer  |
| Introductory courses                      | Introduction to CERT-RMM (4 days; offered 4 times/year in Pittsburgh and DC) Executive workshops and tutorials available on demand  |
| Advanced courses                          | CERT-RMM Intermediate Course (in development for 2011) CERT-RMM CAM BootCamp (pilot scheduled for November 2010) CERT-RMM Role training (Coach, Navigator) CERT-RMM instructor training |

### **CERT-RMM** book publication

Scheduled for publication in November 2010 by Addison-Wesley

Includes full model (v1.0) plus adoption guidance and perspectives of real-world use of the model



Julia H. Allen David W. White

### Resilience measurement & analysis



Area of research growing out of CERT-RMM development

Focuses on the development of adequate measures to determine transformation of operational resilience management system

Focuses on performance measurement—how well are we doing?

Includes both qualitative and quantitative measurements

Measurement users group (RMM MUG) forming—Fall 2010 opportunity to join a measurement cohort and share

## One RMM Risk ecosystem

- Incident Management and Control (IMC)
- Vulnerability Analysis and Resolution (VAR)
- Compliance Mgmt. (COMP)
- Technology Management (TM)
- Knowledge and Information Management (KIM)
- Asset Definition and Management (ADM)
- Service Continuity (SC)

- Controls Management (CTRL)
- Enterprise Focus (EF)
- Monitoring (MON)

### Alignment with NIST Risk Management Framework

### **RMM Risk Eco-System**

Focused on operational <u>risk</u> <u>management</u> process

Provides the basis to actualize the NIST view of risk management (e.g. methods to examine conditions and consequences and link assets to services)

Provides the basis for a sustainable, repeatable, efficient and measurable risk management process

#### **NIST RMF**

Practical guidance for <u>risk</u>
<u>assessment</u> of IT systems
and application of controls

Provides foundation for the development of a threat management program based on control selection

### **CERT-RMM** by the numbers

4

Process Categories 26

**Process Areas** 

256

**Specific Practices** 

94

**Specific Goals** 

260

L2 Generic Practices

52

L3 Generic Practices

Process Categories

Process Areas

Specific Practices

Specific Goals

Practices

L3 Generic Practices

#### **CERT-RMM** coverage of codes of practice

#### Currently mapped to CERT-RMM:

- BS25999-1:2006
- CMMI v1.2
- CMMI for Services
- CobiT 4.1
- COSO ERM
- DRII GAP
- FFIEC Handbooks (Security, BCP)
- ISO 20000-1:2005(E)
- ISO 20000-2:2005(E)
- ISO 24762:2008(E)
- ISO 27001:2005

#### In progress or consideration:

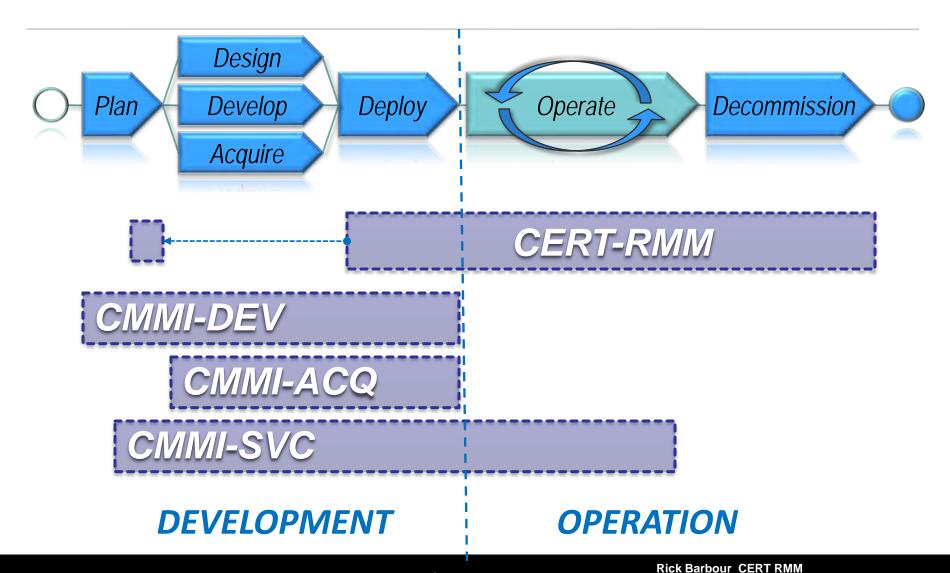
ISO SE7 Application Security Std

HR1-Title 9 Voluntary Standard (TBD)

NIST standards/FISMA provisions

Documented in the REF Code of Practice Crosswalk, v0.95R to be updated with release of RMM version 1.0

### **CERT-RMM** position in lifecycle





### **Resiliency Project Members**

AMD IBM

Ameriprise JPMorgan Chase

Bank of America Key Bank

Carnegie Mellon KPMG

Capital Group MasterCard

Citicorp Marshall and IIsley

Discover Financial NY Federal Reserve Bank\*

EMC PNC Bank

DRII US Bank

FSSCC R&D\* Wachovia

RMM codifies best practices for security and business continuity from world leading organizations and numerous standards and codes



Financial Services Technology Consortium



### **Example: Asset Definition & Management**

| Goals                                   | Practices  |
|---|--|
|   | ADM:SG1.SP1 Inventory Assets                         |
| ADM:SG1 Establish Organizational Assets | ADM:SG1.SP2 Establish a Common Understanding         |
|   | ADM:SG1.SP3 Establish Ownership and Custodianship    |
| ADM:SG2 Establish Relationship          | ADM:SG2.SP1 Associate Assets with Services           |
| Between Assets and Services             | ADM:SG2.SP2 Analyze Asset-Service Dependencies       |
| ADM:SG2 Managa Assats                   | ADM:SG3.SP1 Identify Change<br>Criteria              |
| ADM:SG3 Manage Assets                   | ADM:SG3.SP2 Maintain Changes to Assets and Inventory |

#### Institutionalizing Asset Definition & Management

| Goals                                    | Practices  |  |  |  |
|--|--|--|--|--|
|  | ADM:SG1.SP1<br>Inventory Assets                      |  |  |  |
| ADM:SG1 Establish Organizational Assets  | ADM:SG1.SP2 Establish a Common Understanding         |  |  |  |
| Augus                                    | ADM:SG1.SP3 Establish Ownership                      |  |  |  |
|  | and Custodianship                                    |  |  |  |
| ADM:SG2 Establish                        | ADM:SG2.SP1 Associate Assets with Services           |  |  |  |
| Relationship Between Assets and Services | ADM:SG2.SP2 Analyze Asset- Service                   |  |  |  |
|  | Dependencies   |  |  |  |
| ADM:SG3 Manage                           | ADM:SG3.SP1<br>Identify Change<br>Criteria           |  |  |  |
| Assets                                   | ADM:SG3.SP2 Maintain Changes to Assets and Inventory |  |  |  |

#### A managed process is:

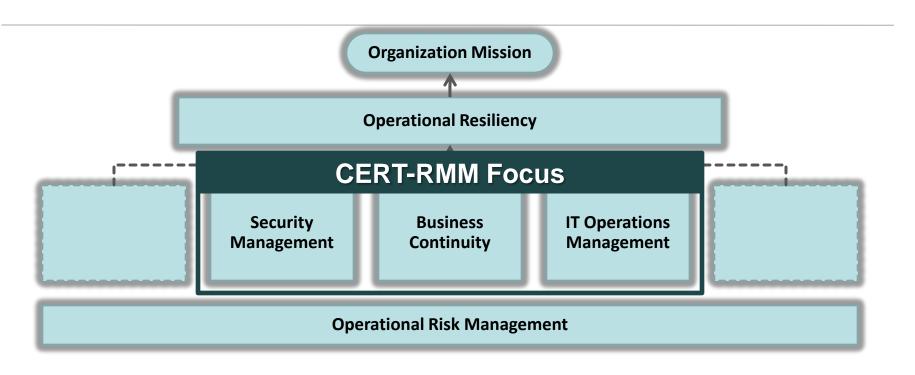
- Governed
- Executed according to policy
- Employs skilled people
- Involves relevant stakeholders
- Monitored, controlled, and reviewed
- Evaluated for adherence to the organization's process description
- Regularly reviewed with senior management

#### Practice example: ADM.SG1.SP1-Inventory Assets

To institutionalize the performance of the "Inventory Assets" practice, you must commit to and perform these supporting practices:

| Institutionalizing Factor     | Institutionalizing Practice   |
|-------------------------------|---|
| Governed                      | There is a policy requiring periodic asset inventory activities; the activity has oversight and corrective actions are taken when necessary |
| Employs skilled people        | Staff involved in the practice have the appropriate skill levels and training   |
| Involves stakeholders         | Asset owners and custodians are involved; all involved in protecting and sustaining the asset are involved                                  |
| Monitored and controlled      | The process is measured to determine effectiveness. Examples: % of assets inventoried; # of changes to inventory in a given period          |
| Evaluate adherence            | The process as performed is verified to be aligned with the process definition  |
| Review with senior management | Keep management informed on the results of the process and identify and resolve issues  |

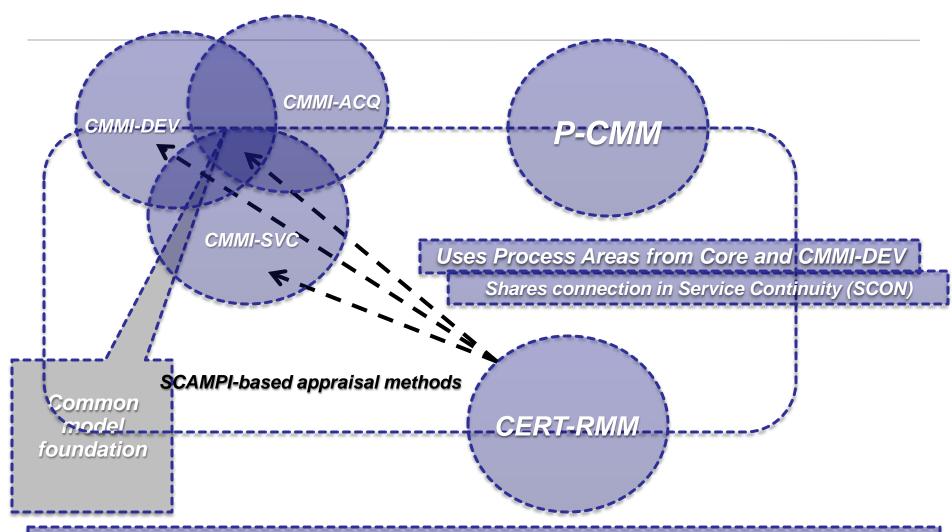
#### **CERT-RMM** principle of convergence



Operational resilience is directly affected by convergence

Organizational mission is directly affected by operational resilience

#### **Positioning CERT-RMM in CMMI**



Extending process improvement capabilities to the operations phase of the lifecycle





## **Proactive Process Deployment**

11/19/2010



Pam Hudson
LM Aero Site Coordinator
Pamela.j.hudson@lmco.com

### **Topics**

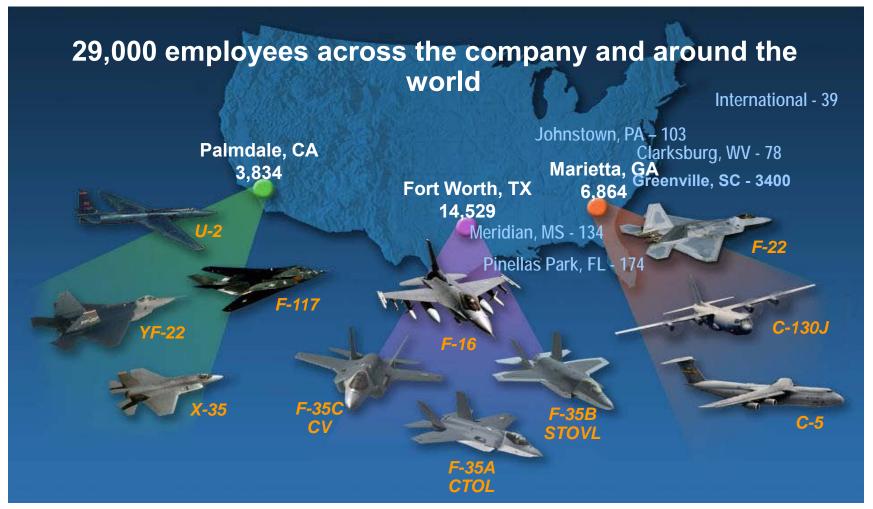


- **➤ Lockheed Martin Aeronautics Overview**
- OSP Deployment Plan
- OSP Deployment Process
- OSP Deployment Event Planning
- Conclusions



## Lockheed Martin Aeronautics Overview







### **Topics**



- Lockheed Martin Aeronautics Overview
- **≻OSP Deployment Overview**
- OSP Deployment Process
- OSP Deployment Event Planning
- Conclusions



## Terminology – Organizational Standard Processes (OSP)



 OSP is the set of AeroCodes that are used as the basis for establishing common <u>development</u> processes across Aeronautics. The OSP describes the fundamental processes that must be incorporated into the defined processes that are implemented by functions and on programs across Aero.



# Terminology – Program Defined Process (PDP)



- PDP is the Program Defined Process used by personnel assigned to a program when executing work on the program
  - A PDP provides a basis for planning, performing, and improving the program tasks and activities. It is tailored from the OSP to meet the objectives, constraints, and environment of a specific program, in accordance with the organization's process tailoring criteria and guidelines.
- The PDP is documented in the Program Adoption of the OSP (PAOSP) for approval and configuration control



## **Terminology - Tailoring**



- Tailoring is required for deletions, modifications, and substitutions to process requirements, including content (but not format) of work products
  - Or when a process requirement is inappropriate for a particular contract, a tailoring is requested
- Approved tailorings are referenced in the PAOSP



## **OSP Deployment Objectives**



- Ensure all Aero programs are utilizing the best available processes to execute their development projects
- Reinforce the use of OSP AeroCodes to document and communicate Aero's best practices
- Identify best practices on programs for inclusion in OSP AeroCodes
- Generate and verify a compliant set of program plans and processes tailored to meet business needs



## **OSP Deployment Plan**



#### LM Aero Strategy

- Bring current programs to OSP-Compliance
- Deploy OSP to all new pursuits
- Deploy OSP changes to programs already compliant, when required

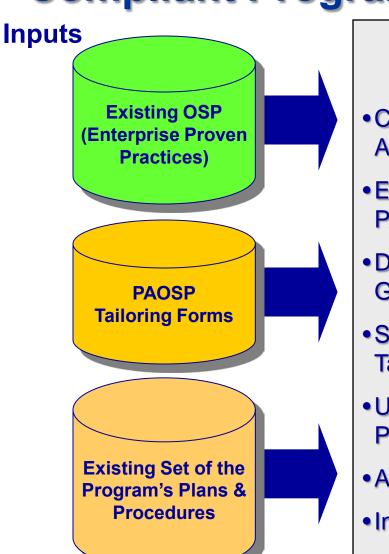
#### OSP Deployment Approach

- Conduct gap analysis events to accelerate development of compliant program plans
- Identify gaps between OSP and program plans
- Establish set of processes used on each program based on the OSP and record them in a PAOSP
- Develop/update and approve plans to incorporate processes, especially the PMP and SEMP



## OSP Deployment To Confirm A Compliant Program Baseline

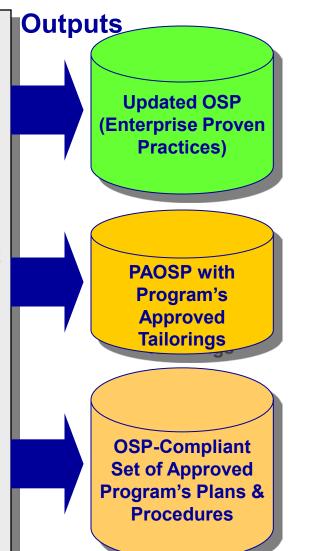




Enterprise Process Integration

#### **Deploy OSP**:

- Conduct Gap Analysis
- Establish initial PAOSP
- Develop/Implement
   Gap Closure Plans
- Submit/Approve Tailoring Requests
- Update/Approve Program Plans
- Approve PAOSP
- Improve OSP



## **Example of PAOSP Spreadsheet**



|           |                    |  |   |             |         |                   |              | Resul    | t of Evalua                                 | ition |
|-----------|--------------------|--|---|-------------|---------|-------------------|--------------|----------|---|-------|
| Domain    | AeroCode<br>Number | Title  | Description/Objective   | Owner       | Do THOS | No. of the second | The The Land | witter a | O de la |       |
|           |                    |  | This process outline the activities and infromation required of all participants during the final stage |             |         |                   |              |          |   |       |
| PM        | AC-XXXX            | Capture Transition                             | of the pursuit  | John Doe    | process | у                 |              |          |   |       |
|           |                    | Program Management<br>Contract Close-out       | To identify the responsibilities of<br>the Program Manager and the<br>Program Leadership Team for the   |             |         |                   |              |          |   |       |
| PM        | AC-XXXX            | Tasks  | Contract Close-out  | John Doe    | process |                   |              | у        |   |       |
|           |                    | Build-to-Package<br>Process Control Manual     | The Build-to-Package Process<br>Control Manual (BTPCM) - Design<br>describes the LM Aero BTP -          | James       |         |                   |              |          |   |       |
| Eng       | AC-XXXX            | - Design                                       | Design processes per  | Smith       | process |                   | У            |          |   |       |
|           |                    | Integrated Cost and<br>Schedule - Earned Value | The Integrated Cost and Schedule (ICAS) - Earned Value Management System (EVMS)                         |             |         |                   |              |          |   |       |
| PM        | AC-XXXX            | Management                                     | process is the single   | Mary Jones  | process |                   | У            |          |   |       |
| Tank Duk  | 4.0 22222          |  | The Technical Publication Development & Support process provides the means to transform                 | Court Coult |         |                   |              |          |   |       |
| Tech Pubs | AC-XXXX            | Process  | engineering   | Carol Smith | process |                   | У            |          |   |       |



### **Topics**



- Lockheed Martin Aeronautics Overview
- OSP Deployment Plan
- **≻OSP Deployment Process**
- OSP Deployment Event Planning
- Conclusions



## **OSP Deployment Responsibilities**



- Functions (Process Owners)
  - Assist development of, review & approve program plans
  - Work with program to establish PDP including any needed tailoring
- Program Manager or Equivalent
  - Supported by program Subject Matter Experts (SMEs)
  - Oversees the development of program plans required by functional processes
  - Establishes the PDP including any needed tailoring
  - Oversees the development and implementation of gap closure plans
- Enterprise Process Integration
  - Facilitates function and program assessment of plans
  - Aids in review and approval of plans and tailoring
  - Drives deployment effort to conclusion



## **Gap Analysis Review Steps**



- Review OSP against Program plans to identify any differences (gaps) – via self-assessment between program POCs and functional SMEs
- 2. Identify and address gaps between OSP and Program plans via gap closure plans

**Gap**: is an identified *non-compliance* to a specific OSP AeroCode or process in an OSP AeroCode which the program/project intends to comply with or tailor.

- 3. Record results in PAOSP Spreadsheet
- 4. Update, submit and approve Program plans



# Step #1 – Review OSP Against Program Plans



 Review the existing plans against the applicable process checklist and/or AeroCodes to identify gaps

Or, if plans don't exist...

 Discuss program planning with the applicable SME and program manager to determine if the steps in the AeroCode will be followed



## Step #2 - Identify & Address Gaps



- Gap items are typically
  - Program actions
    - Implement the OSP on the program
    - Update / develop required program plans and submit for approval
  - Function actions
    - Improve / update OSP (AeroCodes)
    - Support programs to develop/update plans
    - Provide training
- POCs are assigned to develop gap closure plans
- Functional and program leadership monitor implementation of gap plans until closure



## Step #3 – Record Results



- Based on the review of the plan or program planning, determine if the AeroCode will be:
  - Used As Written
    - Use or import process asset without deletions or substitutions
  - Tailored
    - Modify for inclusion with deletions or substitutions
  - Not Applicable
    - None of the AeroCode applies based on the program's contract or life cycle
  - Substitute with Program Implementation
    - Create new process asset to replace an AeroCode



## Step #3 – Record Results (cont'd)



- Capture decisions in PAOSP worksheet
  - As program manager or delegates reviews the OSP and determines its applicability on the program, documentation of this decision is captured in the PAOSP spreadsheet
  - Authors of the applicable program plans will use the PAOSP worksheet as guidance in creating / updating their plan

|        |                    |                    |                                     |          |         |        |        | Result       | of Evalua  | tion |
|--------|--------------------|--------------------|-------------------------------------|----------|---------|--------|--------|--------------|--|------|
| Domain | AeroCode<br>Number | Title              | Description/Objective               | Omer     | DE THE  | zat ka | Tsed & | Witter Allow | on the state of th |      |
| Domain | Turnber            | Title              | This process outline the activities |          |         | -      |        |              |  |      |
|        |                    |                    | and infromation required of all     |          |         |        |        |              |  |      |
|        |                    |                    | participants during the final stage |          |         |        |        |              |  |      |
| PM     | AC-XXXX            | Capture Transition | of the pursuit                      | John Doe | process | У      |        |              |  |      |
|        |                    |                    | To identify the responsibilities of |          |         |        |        |              |  |      |
|        |                    | Program Management | the Program Manager and the         |          |         |        |        |              |  |      |
|        |                    | Contract Close-out | Program Leadership Team for the     |          |         |        |        |              |  |      |
| PM     | AC-XXXX            | Tasks              | Contract Close-out                  | John Doe | process |        |        | у            |  |      |



# Step #4 – Update and Approve OSP-Compliant Program Plans



- Update existing program plan or develop new program plans
- Submit program plans to the applicable functional SME for review and comments
- Functional SME approves the plan (original and updated versions) and any NA's



### **Topics**



- Lockheed Martin Aeronautics Overview
- Enterprise Common Process Management
- OSP Deployment Plan
- OSP Deployment Process
- **≻OSP Deployment Event Planning**
- Conclusions





#### OSP Deployment Event Schedule Summary

#### Day 1: EPI, PM, F&BO, MM & Eng

- Opening Event Brief Purpose,
   Objectives, etc.
- Program Management Plan (PMP)
- IMP & IMS
- Communication Plan
- Monitor and Control Planning (PMP)
- Resource Plan
- EVMS (PMP)
- Estimating & Pricing (PMP)
- Strategic Sourcing Plan
- Subcontract Mgt Plan
- Configuration Mgt Plan

#### Day 2: Eng, PM & F&BO

- Data Mgt Plan
- Risk & Opportunity Mgt Plan
- SEMP & Technical Planning
  - Requirements / WPEs
  - Verification / Validation
  - Architecture
  - Preliminary & Detail Design
  - Implementation

#### Day 3: Eng, PPQA, & EPI

- SEMP & Technical Planning
  - Product Integration
  - BTP / WPEs
- Software Development Plan
- Measurement and Analysis Plan
- Quality Assurance Plan
- Remaining OSP Assessments

#### Day 4: All

- Create Event Outbrief
- Conduct Event Outbrief

Note: If team cannot hold to schedule, then parallel gap sessions will be conducted

# Program OSP Gap Analysis Objectives



- Inventory the program defined processes by dispositioning the "Core" OSP AeroCodes
  - Accept as is
  - Accept with tailorings
  - Not applicable: due to program business need
  - Substitute program process implementation
  - Defer: discuss during follow-on telecon
- Determine what actions, if any, are required to ensure compliance with the LM Aero Process Policy
  - Program actions
  - Core Function actions



## **Program Outcomes**



- Gap analysis event ends when...
  - Core AeroCodes in the OSP are dispositioned
  - Initial PAOSP worksheet is completed and tailorings are identified
  - Gap action plans are developed and POCs assigned
- Event follow-up ends when...
  - Final PAOSP worksheet is completed and tailorings are dispositioned
  - Any plan updates are completed and approved
  - Gap action plans are completed



## **OSP Deployment Monitoring**



| Initial OSP Deployment Status Summary |          |              |                     |  |            |                  |                                 |  |  |
|---------------------------------------|----------|--------------|---------------------|--|------------|------------------|---------------------------------|--|--|
|                                       | Event St | Event Status |                     | OSP Assessment                                 |            |                  |                                 |  |  |
| Program/<br>Project                   | Planned  | Comp         | Assmt's<br>Complete | Tailorings<br>Complete -<br>Approved/<br>Total | Acceptance | Program POC      | Comments                        |  |  |
| F-XX                                  | 2007     | 2007         | 100%                | 6/6  | Complete   | Jon Doe 762-1000 | Initial OSP Deployment Complete |  |  |
| F-YY                                  | 2007     | 2007         | 100%                | 2/2  | Complete   | Jon Doe 762-1000 | Initial OSP Deployment Complete |  |  |
| F-ZZ                                  | 6/2008   | 6/2008       | 100%                | 3/3  | Complete   | Jon Doe 762-1000 | Initial OSP Deployment Complete |  |  |
| C-1                                   | 8/2008   | 8/2008       | 100%                | 2/2  | Complete   | Jon Doe 762-1000 | Initial OSP Deployment Complete |  |  |
| F-A                                   | 1/2009   | 1/2009       | 100%                | 0/0  | Complete   | Jon Doe 762-1000 | Initial OSP Deployment Complete |  |  |
| F-B                                   | 6/2009   | 6/2009       | 100%                | 1/1  | Complete   | Jon Doe 762-1000 | Initial OSP Deployment Complete |  |  |
| C-2                                   | 11/2009  | 11/2009      | 100%                | 0/0  | Complete   | Jon Doe 762-1000 | Initial OSP Deployment Complete |  |  |
| C-3                                   | 12/2010  | 12/2010      | 25%                 |  | In-work    | Jon Doe 762-1000 | Deployment Event<br>Scheduled   |  |  |
| Non-Program Deployment Events         |          |              |                     |  |            |                  |                                 |  |  |
| Tool XYZ                              | 8/2009   | 8/2009       | 100%                | N/A  | N/A        | Jon Doe 762-1000 | Initial OSP Deployment Complete |  |  |





## Questions?





## Divide and Conquer – Marshalling the "Masses" to Tackle CMMI®

November 18, 2010



Robert Tuthill
Six Sigma Black Belt
Joe Vandeville
Associate Technical Fellow
Northrop Grumman Corporation

#### Agenda



- The Set-up
- How CMMI® Gets Done
- Options for Implementation
- Realize the Organization is a System
- Implementing a Systems Approach to CMMI®
- Identifying the Components of the System
- Populating the Systems Framework
- Summary

<sup>&</sup>lt;sup>®</sup> CMMI is registered in the U.S. Patent and Trademark Office by Carnegie Mellon University.

### The Set-up



- Its midnight, and a small group of process experts are burning the candles, preparing for an up-coming appraisal
  - Sound familiar?

#### How CMMI Gets Done



#### A Common Method

- In many organizations, a small cadre of process experts develops the CMMI approach for their organization
  - Map CMMI to processes
  - Ensure processes comply
  - Identify and collect artifacts
- Understanding the Evolution of the Common Method
  - CMM® began as a Software model, so naturally a Software group generally comprised the cadre responsible for implementation
  - When the CMMI for System and Software came out, many organizations expanded the responsibility for implementation to include the larger Engineering group
    - · The scope of implementation remained primarily within the Engineering disciplines
  - With the IPPD extension of CMMI, the potential for a broader implementation outside the boundaries of Engineering disciplines became a practical option for organizations

#### How CMMI Gets Done



- Cultural Roadblocks to an Expanded Implementation
  - Given the evolution of the model, and its Engineering-centric legacy, process experts within Engineering disciplines typically remain at the center of implementation efforts
    - The CMM/CMMI model went through an evolutionary expansion yet that hasn't necessarily translated as a change in the size and make-up of the implementation team
      - The Engineering-centric cadre remains relatively constant in many organizations
  - The result:
    - A broad organizationally based model is often implemented by a small specialized group



- Overcoming the Roadblocks
  - How can a small cadre effectively implement a broad model so that the organization at large will understand, embrace, and institutionalize the implementation?
    - Option 1:
      - Restrict the organizational scope of the model primarily to Engineering activities
    - Option 2:
      - Acquire the necessary resources to expand the scope beyond Engineering to include other departments
        - » E.g. Program Management, Sub-Contract Management, or Human Resources



#### • Option 1:

- Consider the consequences when the scope is restricted to Engineering
  - Although the approach is easier for an Engineering-based cadre to manage, there are downsides:
    - Project management functions (e.g. PP, PMC, IPM, RSKM, CM, SAM, DAR)
       may be limited to technical management
      - » This is likely to exclude important higher level non-engineering functions
    - The restricted approach leaves an organization with the inability to capture:
      - » Program Management plan
      - » Non-technical risks related to program execution
      - » Staffing resources associated with contract management, customer interfaces, and program management



#### • Option 1:

- Consequences Continued
  - Other disciplines within the enterprise fail to see the value of the CMMI model when it is implemented with an engineering-centric approach
    - They view the model as something important only to engineering (engineering owns it) and of no real use to the program at large
  - The Result:
    - A restricted view of CMMI applicability
    - This may be a viable option for some organizations, but not all



- Option 2:
  - Consider expanding the scope beyond Engineering
    - Although the approach is more challenging for an Engineering-based cadre to manage, there are upsides:
      - Provides a more realistic, inclusive view of the Enterprise
      - The payoff is worth the effort
        - » It results in a more robust implementation of the model, involving a greater representative cross-section of the enterprise
    - Engineering typically provides the CMMI knowledge-base and the personnel experienced in pulling appraisals together
      - The expanded approach requires bringing in players from other departments, so how does engineering steer this effort and involve these players?
    - The answer
      - You trick them
        - » Develop methods and management support to solicit assistance from departments outside Engineering

## Realize the Organization is a System



- Once the decision is made to employ an expanded approach beyond Engineering, another decision must be made
  - What will be scoped in and out of the expanded model implementation?
- What are the functional elements of the "scoped" organization
  - Organizational charts and charters can help determine who has the mandate for these functions
    - Example: the CMMI model addresses resources/facilities (e.g. PP SP2.4 & IPM SP1.3) and organizational training (OT)
      - Determine which functional elements within the organization typically handle those areas.
- By viewing the organization as a system, the inclusion of critical organizational elements can be determined to satisfy the model
  - Example: including Program Management and Global Supply Chain can be useful in satisfying PP, PMC, IPM, and SAM

### Implementing a Systems Approach to CMMI



- An effective approach to encourage participation of non-Engineering organizations
  - Consider techniques to elicit a sense of ownership of parts of the model among other disciplines
    - Develop an initial mapping of the "owning" organizations to the CMMI processes
    - Identify the organizational entities (think system components) that might "own" portions of the CMMI model (think requirements)
    - Identify whether the organizational entities have a "project" or "organizational" responsibility in relation to the process area
      - This will tell you where artifacts will come from
    - For each "owning" organization identify the CMMI processes that they own
    - Work through executive management to identify process subject matter experts (SMEs) in each discipline to assist in the effort
    - Hold meetings with the organizational SMEs to secure their comments and concurrence on the mapping



The CMMI model (process areas and practices) can be viewed as the allocated requirements

Organizational departments can be viewed as the components of the System

|        |   |                                      |   | 0  | Indica   | ates th   | at activ   | ity is   | prima  | rily a function   | onal (org  | ganizational   | ) activity   |   |
|--------|---|--------------------------------------|---|--|--|---|--|--|--|---|--|--|--|---|
|        |   |                                      |   |  |  |   |  |  |  |   |  |  |  |   |
|        |   | LEVEL 2                              |   |  |  |   |  |  |  |   |  |  |  |   |
|        |   |                                      | Subject Matter<br>Expert  | SYS  | sw   | T&E   | LOG  | HW   | QA   |   |  | Global<br>Supply<br>Chain  | Supplier<br>Qual   | Prog<br>Mgmt  |
|        |   |                                      |   |  |  |   |  |  |  |   |  |  |  |   |
|        |   |                                      |   |  |  |   |  |  |  |   | Р  | Р  |  | Р   |
| SF     |   |                                      |   | P  | Р  | P   | Р  | Р  |  |   | Р  |  |  |   |
| SF     | P-1.3   | Define project life cycle            |   | Р  | Р  |   |  |  |  |   | Р  |  |  | Р   |
| SF     | P-1.4   | Determine estimates of effort & cost |   | Р  | Р  | Р   | Р  | Р  |  |   | Р  | Р  |  |   |
| SG-2 [ | Devel   | op a Project Plan                    | •   | •  |  |   |  |  |  |   |  |  | l  |   |
| SF     | P-2.1   | Establish the budget & schedule      |   |  |  |   |  |  |  |   | Р  |  |  | P   |
| SF     | P-2.2   | Identify project risks               |   | Р  |  |   |  |  |  |   | Р  |  |  | Р   |
|        |   |                                      |   |  |  |   |  |  |  |   |  |  |  | Р   |
|        |   |                                      |   | Р  | Р  | Р   | Р  | Р  |  |   | Р  |  |  | Р   |
| SF     | P-2.5   | Plan for needed knowledge & skills   |   | Р  | Р  | Р   | Р  | Р  |  |   | Р  |  |  | Р   |
| SF     | P-2.6   | Plan stakeholder involvement         |   |  |  |   |  |  |  |   | Р  |  |  | Р   |
| SF     | P-2.7   | Establish the project plan           |   | Р  | Р  | Р   |  |  |  |   | Р  |  |  | Р   |
|        |   |                                      |   |  |  |   |  |  |  |   |  |  |  |   |
| SF     | P-3.1   | Review plans that affect the project |   |  |  |   |  |  |  |   | Р  |  |  | Р   |
| SF     | 2-3.2   | Reconcile work & resource levels     |   |  |  |   |  |  |  |   | Р  |  |  | Р   |
|        |   | Objects to the second through        |   | 1  | <b>—</b>   | <del> </del>  | 1  |  |  | 1   | Р  |  |  | Р   |
|        | \$G-1 II  \$F  \$F  \$F  \$F  \$F  \$F  \$F  \$F  \$F | SG-1 Estab                           | SG-1 Establish Estimates  SP-1.1 Estimate the scope of the project SP-1.2 Establish estimates of work product & task attribute SP-1.3 Define project life cycle | SG-1 Establish Estimates  SP-1.1 Estimate the scope of the project SP-1.2 Establish estimates of work product & task attribute SP-1.3 Define project life cycle SP-1.4 Determine estimates of effort & cost  SG-2 Develop a Project Plan SP-2.1 Establish the budget & schedule  SP-2.2 Identify project risks SP-2.3 Plan for data management SP-2.4 Plan for project resources SP-2.5 Plan for needed knowledge & skills SP-2.6 Plan stakeholder involvement SP-2.7 Establish the project plan  SG3 - Obtain Commitment to the Plan  SP-3.1 Review plans that affect the project | LEVEL 2  PROJECT PLANNING  Subject Matter Expert  SG-1 Establish Estimates  SP-1.1 Estimate the scope of the project  SP-1.2 Establish estimates of work product & task attribute  SP-1.3 Define project life cycle  SP-1.4 Determine estimates of effort & cost  P  SG-2 Develop a Project Plan  SP-2.1 Establish the budget & schedule  SP-2.2 Identify project risks  SP-2.3 Plan for data management  SP-2.4 Plan for project resources  SP-2.5 Plan for needed knowledge & skills  SP-2.6 Plan stakeholder involvement  SP-2.7 Establish the project plan  SP-3.1 Review plans that affect the project  SP-3.2 Reconcile work & resource levels | LEVEL 2  PROJECT PLANNING  Subject Matter Expert  SP-1.1 Estimate the scope of the project  SP-1.2 Establish estimates of work product & task attribute  SP-1.3 Define project life cycle  SP-1.4 Determine estimates of effort & cost  P  P  SG-2 Develop a Project Plan  SP-2.1 Establish the budget & schedule  SP-2.2 Identify project risks  SP-2.3 Plan for data management  SP-2.4 Plan for project resources  SP-2.5 Plan for needed knowledge & skills  SP-2.6 Plan stakeholder involvement  SP-2.7 Establish the project plan  SP-3.1 Review 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the scope of the project & P P P P P P P P P P P P P P P P P P | LEVEL 2  PROJECT PLANNING  Subject Matter Expert  SYS SW T&E LOG HW QA Process Grp Mgmt Supply Chain  SG-1 Establish Estimates  SP-1.1 Estimate the scope of the project | LEVEL 2  PROJECT PLANNING  Subject Matter Expert  SYS SW T&E LOG HW QA Process Eng Global Supplier Qual Chain  SG-1 Establish Estimates  SP-1.1 Estimate the scope of the project |



The Systems approach identifies which requirements are satisfied by the project and which are satisfied by the organization

|              |  | 9                        | P<br>0 |    | ates that<br>ates that | l) activity |    |    |                |    |                           |                  |              |
|--------------|--|--------------------------|--------|----|------------------------|-------------|----|----|----------------|----|---------------------------|------------------|--------------|
| SUPPLIER AGE | REEMENT MANAGEMENT                       | Subject Matter<br>Expert | SYS    | SW | T&E                    | LOG         | HW | QA | Process<br>Grp | EM | Global<br>Supply<br>Chain | Supplier<br>Qual | Prog<br>Mgmt |
| SG-1 Esta    | blish Supplier Agreements                |                          |        |    |                        |             |    |    |                |    |                           | •                |              |
| SP-1.1       | Determine acquisition type               |                          | Р      |    |                        |             |    |    |                | Р  | Р                         |                  | Р            |
| SP-1.2       | Select suppliers                         |                          |        | Р  |                        |             | Р  |    |                | Р  | Р                         |                  | Р            |
| SP-1.3       | Establish suppler agreements             |                          |        | Р  |                        |             | Р  |    |                | Р  | Р                         |                  | Р            |
| SG-2 Satis   | fy Supplier Agreements                   |                          |        |    |                        |             |    |    |                |    |                           | •                |              |
| SP-2.1       | Execute the supplier agreement           |                          | Р      | Р  |                        |             | Р  |    |                | Р  | Р                         |                  |              |
| SP-2.2       | Monitor Selected Supplier Processes      |                          | Р      | Р  |                        |             | Р  |    |                | Р  | Р                         |                  | Р            |
| SP-2.3       | Evaluate Selected Supplier Work Products |                          |        |    |                        |             |    |    |                |    |                           |                  |              |
| SP-2.4       | Accept the acquired product              |                          |        | Р  |                        |             | Р  |    |                | Р  |                           | Р                |              |
| SP-2.5       | Transition products                      |                          |        | Р  |                        |             | Р  |    |                | Р  |                           | Р                |              |



|              |  | The Syster expert (SM    |   |    |     |     |    |    | •              | ect m | atter                     |                  |              |  |
|--------------|--|--------------------------|---|----|-----|-----|----|----|----------------|-------|---------------------------|------------------|--------------|--|
|              |  |                          | P Indicates that activity is primarily a project activity                   |    |     |     |    |    |                |       |                           |                  |              |  |
|              |  |                          | O Indicates that activity is primarily a functional (organizational) activi |    |     |     |    |    |                |       |                           |                  |              |  |
|              | LEVEL 3  |                          |   |    |     |     |    |    |                |       |                           |                  |              |  |
| TECHNICAL SO | DLUTION  | Subject Matter<br>Expert | SYS   | SW | T&E | LOG | HW | QA | Process<br>Grp | EM    | Global<br>Supply<br>Chain | Supplier<br>Qual | Prog<br>Mgmt |  |
| SG-1 Sele    | ct Product-Component Solutions                       | •                        | •   |    |     |     |    | ļ  | ļ.             |       |                           |                  |              |  |
| SP-1.1       | Develop alternative solutions and selection criteria |                          | Р   |    |     |     |    |    |                |       |                           |                  |              |  |
| SP-1.2       | Select product-component solutions                   |                          | Р   |    |     |     |    |    |                |       |                           |                  |              |  |
| SG-2 Deve    | elop the Design                                      | •                        |   |    |     |     |    | ļ. |                |       |                           | •                |              |  |
| SP-2.1       | Design the product or product component              |                          |   | Р  |     |     | Р  |    |                |       |                           |                  |              |  |
| SP-2.2       | Establish a technical data package                   |                          |   | Р  |     | Р   | Р  |    |                |       |                           |                  |              |  |
| SP-2.3       | Design interfaces using criteria                     |                          |   | Р  |     |     | Р  |    |                |       |                           |                  |              |  |
| SP-2.4       | Perform make, buy, or reuse analyses                 |                          | Р   | Р  |     |     | Р  |    |                | Р     | Р                         |                  | Р            |  |
| SG-3 Impl    | ement the Product Design                             |                          |   |    |     |     |    |    |                |       |                           |                  |              |  |
| SP-3.1       | Implement the design                                 |                          |   | Р  |     |     | Р  |    |                |       |                           |                  |              |  |
| SP-3.2       | Develop product support documentation                |                          |   |    |     | Р   |    |    |                |       |                           |                  |              |  |



|  |                                     | P Indicates that activity is primarily a project activity O Indicates that activity is primarily a functional (organ |     |    |     |     |    |      |                |    |                           |                  |              |  |
|--|-------------------------------------|--|-----|----|-----|-----|----|------|----------------|----|---------------------------|------------------|--------------|--|
| ORGANIZATIONAL PROCESS                 | DEFINITION                          | Subject Matter<br>Expert   | SYS | sw | T&E | LOG | HW | QA   | Process<br>Grp | EM | Global<br>Supply<br>Chain | Supplier<br>Qual | Prog<br>Mgmt |  |
| SG-1 Establish Organiza                | tional Process Asset                | S  |     |    |     |     |    |      |                |    |                           |                  |              |  |
| SP-1.1 Establish star                  | ndard processes                     |  | 0   | 0  | Q   | 0   | 0  | O, P | 0              | 0  |                           | 0                | 0            |  |
| SP-1.2 Establish life-<br>descriptions | cycle model                         |  | 0   | 0  | 1   |     |    |      |                | 0  |                           |                  |              |  |
| SP-1.3 Establish tailo guidelines      | oring criteria and                  |  | T   |    |     |     |    |      | 0              | 0  |                           | 0                | 0            |  |
| SP-1.4 Establish the measurement       | _                                   |  |     |    |     |     |    |      | 0              | 0  |                           |                  | 0            |  |
| SP-1.5 Establish the asset library     | organization's process              |  |     |    |     |     |    |      | 0              | 0  |                           |                  | 0            |  |
|  | k environment<br>cess asset library |  |     |    |     |     |    |      | 0              | 0  |                           |                  | 0            |  |
| SG-2 Enable IPPD Mana                  | gement                              |  |     |    |     |     |    |      |                |    |                           |                  |              |  |
| SP-2.1 Establish emp                   | powerment                           |  |     |    |     |     |    |      | 0              | 0  |                           |                  | 0            |  |
| SP-2.2 Establish rule integrated tea   | s & guidelines for<br>ims           |  | 1   | 6  |     |     |    |      |                | 0  |                           |                  |              |  |
| SP-2.3 Balance team                    |                                     |  |     |    |     |     |    |      | 0              | 0  |                           | 0                | 0            |  |

The Systems approach identifies which requirements are allocated to which components (organizational departments), and identifies whether it is an organizational or project function

### Populating the System Framework



- Mapping the Documentation to the Model (Engineering and Non-Engineering)
  - Work with designated process SMEs from each discipline/department to identify the procedures that map to process areas and practices
  - Work with the SMEs to identify specific passages in a document that address the practice
  - Assist SMEs in gap analysis to identify any document deficiencies which require remedial work to satisfy the practice
  - Work with SMEs to identify the work products their processes produce, which correspond to the "expected artifacts" cited in the model
  - Solicit SME assistance in the actual mapping of their procedures and expected artifacts into the CMMI process implementation indicator (PII)
  - Solicit SME assistance in collecting project specific artifacts, and organizing them into specified repositories
  - Work with SMEs to identify the appraisal interview candidates
  - The SMEs become points-of-contact to resolve findings generated from appraisals

#### Summary



- Benefits: Tangible and Intangible
  - Tangible
    - The expanded approach results in robust implementation of the CMMI model, involving critical departments and management functions outside engineering
    - The expanded implementation safeguards against "flag chasing" approaches that rely on convenient, sub-optimized mappings

#### Intangible

- Process subject matter experts (SMEs) from participating disciplines gain exposure to and an appreciation of the benefits of CMMI
  - They become process advocates, carrying the message of the model's usefulness back to their organization
  - Communicating the benefits of CMMI to non-Engineering departments uninvolved in the appraisal process would likely represent an insurmountable challenge for a small cadre of Engineering personnel

# NORTHROP GRUMMAN



# Deploying the Measurement and Analysis Process



Name: William Golaz

Title: LM Fellow & LM Aero Measurement

and Analysis Lead

## **Topics**



- Background
- Problem
- Approach
- Experience
- Resources
- Results
- Summary



### **Lockheed Martin Aeronautics Overview**





## Background



- Lockheed Martin Aeronautics measurement process improvements
  - SEI CMM Level 3 for software 1993
    - SW Standard Metrics
  - SEI CMM Level 4 for software 1999
    - SW Quantitative Management
  - SEI CMMI Level 3 at company level 2007 & 2010
    - Company wide measurement process



## **Problem**



- How to deploy the company Measurement and Analysis process across multiple programs and geographical sites?
  - Institutionalize the M&A process
    - Georgia, Texas, and California
  - Incorporate M&A planning into the program planning
  - Identify and deploy M&A related training
  - Programs already doing most of M&A process

Change company culture



## **Approach**



- Take the Measurement and Analysis process to the programs
  - M&A planning workshops on site with the programs
  - Facilitated by small team of M&A experts
  - Pre-populated M&A planning templates
  - M&A process awareness training prerequisite for participants
  - Met with program management
  - Include current program SMEs and middle management



# Approach (cont.)



- Objective: Develop a 70-80% complete M&A Plan for the program by end of 3 day workshop
- Preparation
  - Schedule workshop with program POC
    - Coordinate appropriate participants
  - Pre-populated plan template with standard content
    - Boiler plate material
    - General measurement traceability data
    - Measurement specification data for standard measures
    - Standard reference to M&A training
    - Place holders for required content



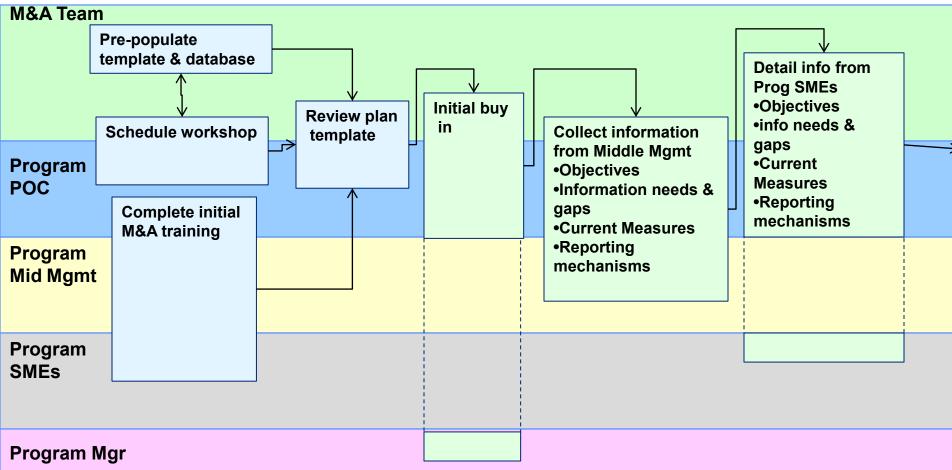
## Approach (cont.)

- Objective: Develop a 70-80% complete M&A Plan for the program by end of 3 day workshop
- Onsite
  - Obtain buy-in from program manager
  - Identify current Information Needs with middle management
  - Review current measures with program SMEs
    - Match to the Information Needs
    - Identify any gaps or duplications
  - Load program data in organizational database
  - Generate plan tables from the database
  - Identify and fill in program specific information in the plan
  - Identify remaining tasks for program POC



## Workshop activities

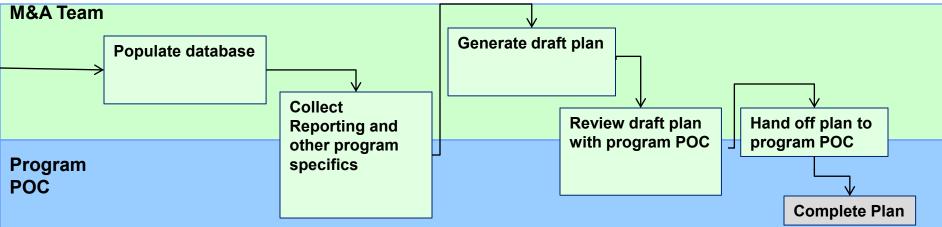






## Workshop activities (cont.)





Program Mid Mgmt

Program SMEs

Notice this frees up the program to continue working

**Program Mgr** 



## **Experiences**

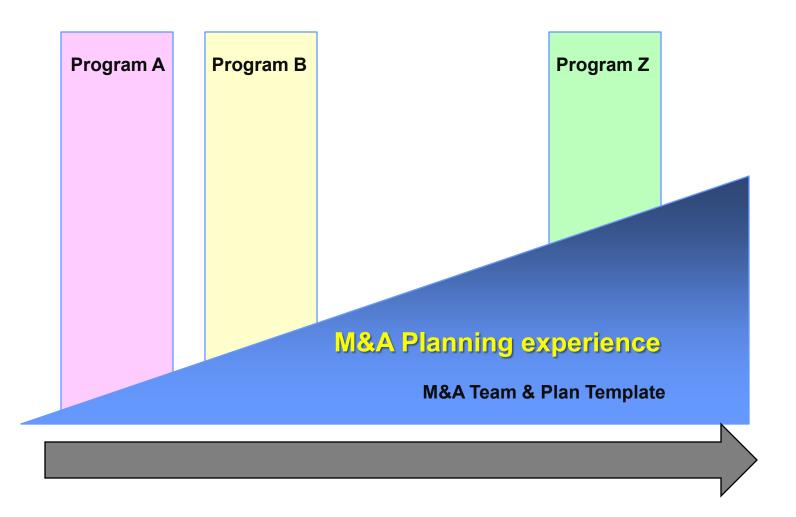


- Programs appreciated the help
  - Going to the program minimized impact to the program
- Distributed planning experience across company
  - M&A Team could take best practices & lessons learned from program to program
- Planning made workshop go smoother
  - Clear expectations and objectives
- Flexibility in execution fit better with program availability
  - Meet with management in a CR or go to their offices
- Meet with program manager helped gain buy in and visibility of M&A planning
- Many times program had been requested to improve their measures just before we arrived



## **Distribution of Lessons Learned**







# **Experiences (cont.)**



- Program follow up to complete the plan sometimes became low priority after we left
  - Took long time to complete
- Program personnel assigned to complete plan sometimes were re-assigned
- Program later did not recognize M&A planning as significant portion of program planning
- Program didn't want to include all measures in their plan
- Program didn't use the plan to mange their measures with
  - tendency to do it like they always have
- Difficult identifying various reporting mechanisms using measures



## Resources



- Resources:
  - Pre-populated M&A plan template
    - Common objectives, information needs and measures
    - Boiler plate information
    - Training references
    - References to standard process
  - Measurement Model Database
    - Specification data for standard measures
    - Common objectives and information needs
    - Able to generate tables for M&A plan



## Results



- Began culture change about use of measurement
  - Everyone uses measurement but they don't plan how they use them or link them to specific information needs
  - Understand the need to document analysis and actions in preparation for management consumption
  - Concept to plan their measurement activities
  - Expanded awareness of M&A infrastructure



## **Summary**



- Institutionalization of the measurement and analysis process
- Culture change
- Take the process to the programs
- Assisted the programs in measurement planning



## **Contact Information**



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# Connecting the Dots: QPM, OPP, CAR, and OPM

CMMI Conference November 15-18, 2010



Diane Mizukami-Williams Northrop Grumman Corporation

Abstract 11177



# What Does HONEST High Maturity Behavior Look Like?

CMMI Conference November 15-18, 2010



Diane Mizukami-Williams Northrop Grumman Corporation

Abstract 11177

#### **Objectives**



- Intended for people who are new to high maturity.
- Shows how inter-connected the high maturity process areas are.
- Stresses how using high maturity can result in success, even in your personal lives
- Will use personal life example to help you understand basic principles.



## Northrop Grumman Information Systems (IS) Sector

#### IS Sector

- 7,000 contracts
- 32,000 employees

#### **Products and Services**

- Mission support
- Cybersecurity
- Enterprise applications
- Command, control, and communications
- IT & network infrastructure
- Management & engineering services
- Intelligence, surveillance, & reconnaissance

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### **CMMI Appraisals**

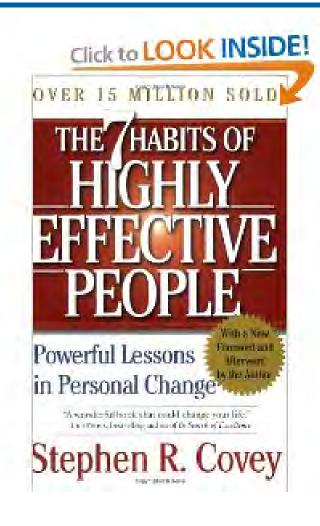
- Over 80 organizations (over 250 projects) appraised at Level 3 or higher
- Completed 32 Level 5 appraisals







#### Almost a Personal Improvement Presentation

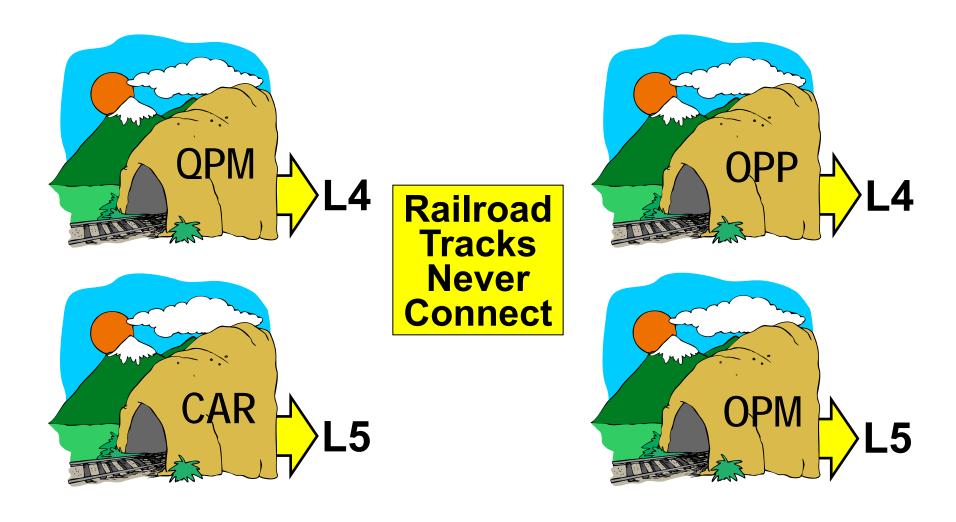


#### **Book contains 7 principles:**

- Principles of Personal Vision (OPM)
- Principles of Personal Management (QPM)
- 8<sup>th</sup> new habit: Principles of Taking High Maturity Seriously

Even self improvement textbooks use high maturity concepts.

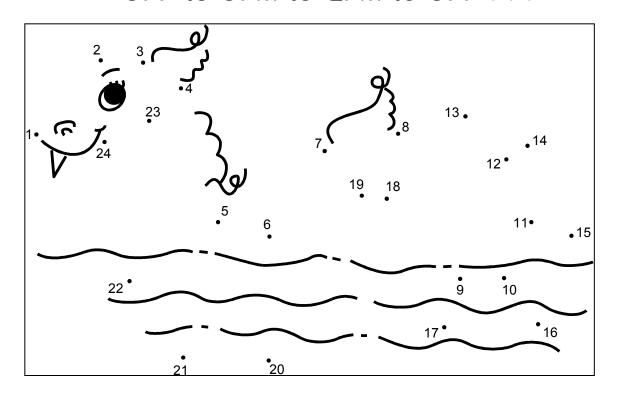
### High Maturity Process Areas Should **NOT** Be Like This



Should not do each process area in isolation and pop out with a level.

#### High Maturity Process Areas **Should** Be Like This

Dot-to-dot where high maturity process areas continually connect to one another, e.g., OPP to QPM to CAR to OPP to OPM to OPP . . .



High maturity continuously bounces back-and-forth between dots.

#### **Examples of Not Connecting the Dots**

- Baselines and models (OPP) are not used by projects (QPM)
- Making improvements (OPM) that are not based on an analysis of existing performance (OPP)
- Managing your project (QPM) without an understanding of your current performance (OPP) Note that baselines and models can be at a project level.
- Not using what projects have learned (CAR) to make organizational improvements (OPM)
- Not using performance measures (QPM) to help figure out the root cause of performance problems (CAR)
- And the list goes on ...

#### Personal Example is Money



- Example shows how I manage money using high maturity concepts
- Use of high maturity concepts helped to reach personal goals (business objectives)
- Many aspects of my personal example can be used to manage spending in organizations

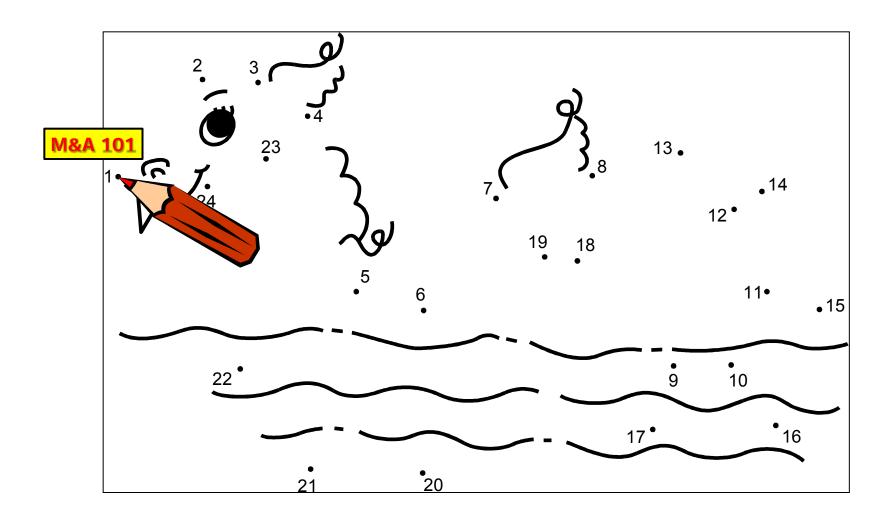
#### When M&A Started

- Moved away from home at 19 years old in 1978 with \$600.
- Worked full time at TRW, Inc. in the graphic art department.
- For no particular reason, immediately started tracking spending.
- Collected barely any metrics (kindergarden M&A)

| <u> </u> |     |                                    |      | JA          | N    | 1979                                    |
|----------|-----|------------------------------------|------|-------------|------|---|
| FI       | r8t | Checking account                   |      | 201         | 1597 | First may                               |
|          |     | TRW check 12-29                    | 1/10 | de in the   | 134  | 295 16                                  |
|          |     |                                    | 1/26 | 100         | 00   | D 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 |
| DPCK     | 089 | Cash-spending money TRW-check 1-12 | 129  | Boss        | 70   | 387 78                                  |
|          |     | menty                              | 100  | Assistant M | 175  | Sor so III                              |
|          |     | TOTAL: \$100.00                    | NO.  | Bon 17      | Car. | LE CKILGE                               |



#### M&A 101 : Baby Metrics



You have to start collecting data, even if you start off with baby M&A.



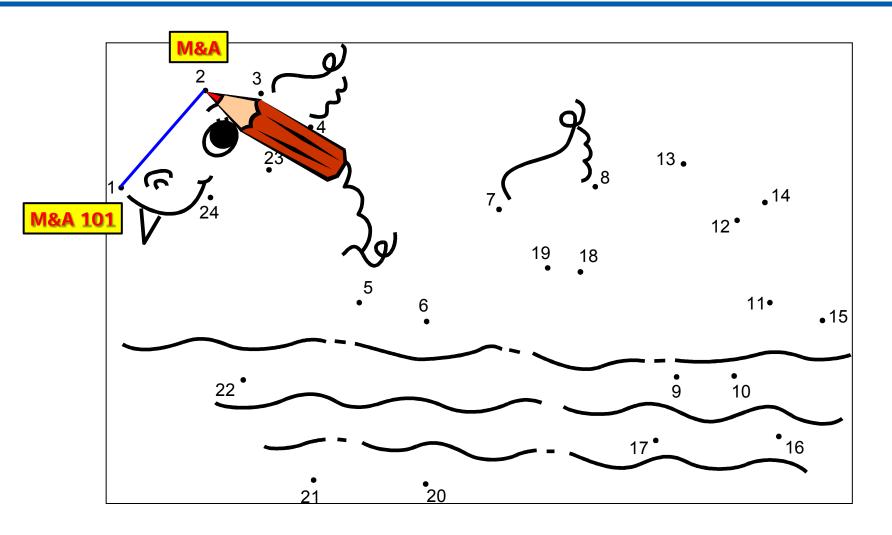
By the end of 1979, M&A quickly evolved to log more details.

| DEC 1979                         |                                  |
|----------------------------------|----------------------------------|
| Received first credit card       | I clearly had no control         |
| CK 308 cosmopolitan / year       | subscription 173 2100 over my    |
| CK 309 Contemposhoes - Pacifi    | c Square - 2 pairs 19/15 76 32   |
| CK 310 Fabric Galaxy - Karens    | 'x-max present 19/15 3180 (1500) |
| CX 31) Surprise Store - Kraig ar |                                  |
| CX 312 Yoke - Marter Mind for    |                                  |
| CX 313 Cash - spending money     |                                  |
| CX 314 May Co 2 shirts Glen      |                                  |
| MASTER Contempo Carualt - Ishii  |                                  |
| MASTER CICOTICE PILLA - 4 all    | 10/                              |

Only interested in total spending (the process, not subprocesses)



### M&A: Grown Up Metrics



As you get used to M&A, you "grow up" and gather more details.





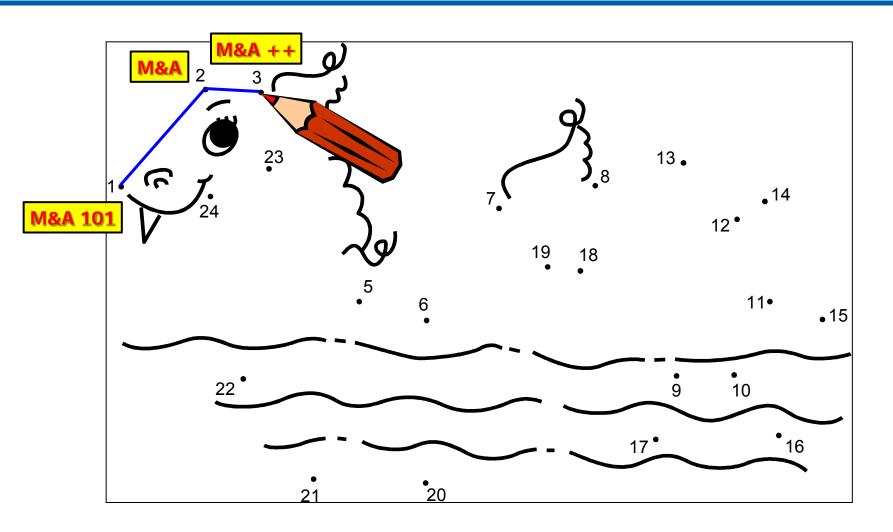
• Soon after, obsessive compulsive disorder kicked in.

| CASH | Breakfast at Mammoth Lodge        | 5/22   | 3 55  |        |                               |
|------|-----------------------------------|--------|-------|--------|-------------------------------|
| CASH | dip on Polaroid for glasses.      | 1 5/22 | 6 36  | - 1    |                               |
| CASH | left beket for full day           | 5/2    | 1300  |        | The second second             |
| CASH | Dinner at Shogun - Denny wedted   | 3/32   | 500   |        | Loggoda                       |
| CASH | Arcade after pinner -80           | +35    | 70200 | E      | Logged a penny. Even          |
| CASH | Swenson recercam-Single cone      | 75/2   | 100   |        | started to log when I found a |
| CASH | Breakfast at The store - Demy mat | 3/23   | 001   | $\leq$ | penny in the parking lot.     |
| CASH | Gas paid to benny furting         | 5 %3   | 10 00 | l      | parking for:                  |
| CASH | 600 paid to cheer forting         | 至923   | 1500  | أفسا   |                               |
|      | Londo pard by Kawaber father      | 五5/53  |       |        |                               |

As you collect data, you may start to realize you need more.



### M&A: Obsessive Compulsive Disorder



The point when you start to care usually leads to high maturity.



### The "Event": My First OPM Business Objective



"Three's Company", i.e., pain, led to my first "business objective"

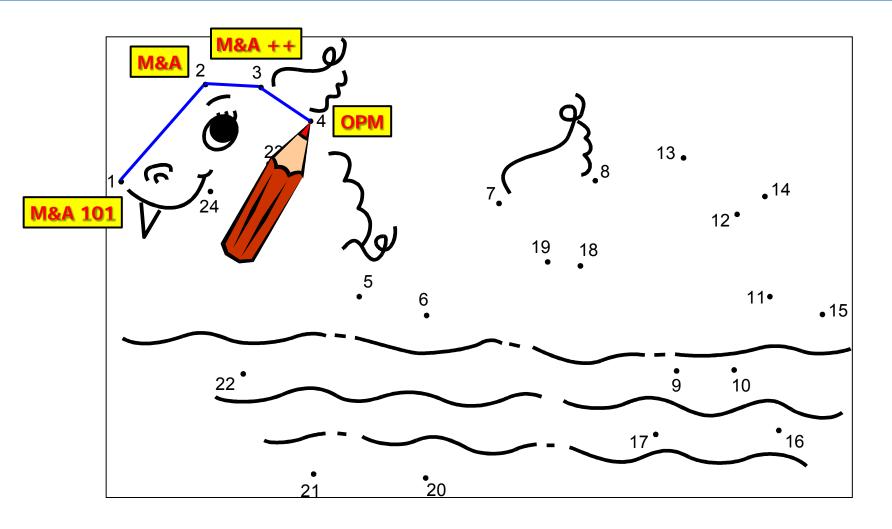
## **OPM** "Business Objective"

Buy a house in Los Angeles before any of my friends by 21 years old.





#### OPM: Vision to Buy a House by 21 Years Old



With OPM, you have a vision to strive for "Principles of Personal Vision"



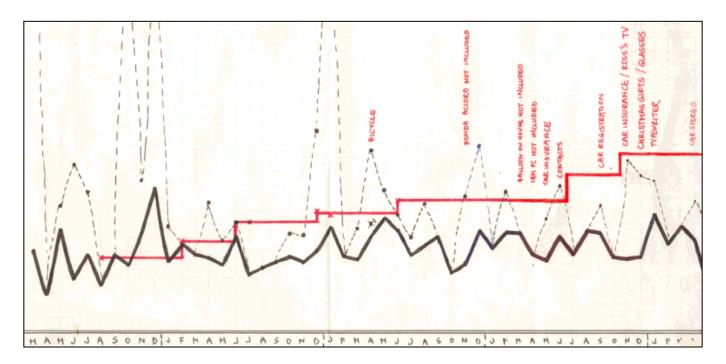
### **QPM: Performance Objectives**

- Process performance objectives:
  - Increase my hourly rate as quickly as possible
  - Control my spending
- Both are measurable objectives.



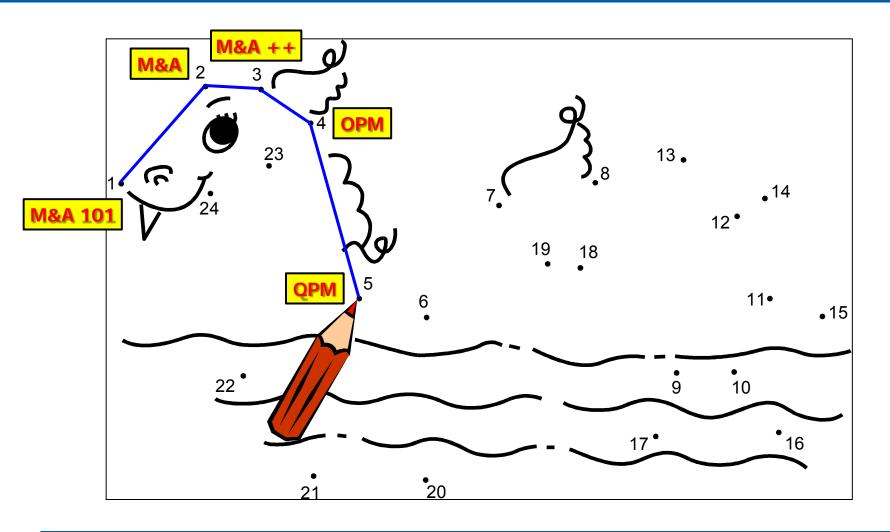
#### **QPM: Monitored Performance**

- Continually tried to understand and control spending.
- Graphed typical spending, actual spending, income, and special causes and tried to reduce variation in typical spending.
- Graph shows typical spending eventually stabilized.





### **QPM: Used Metrics to Control Spending**



Controlling spending includes stabilizing and reducing variation.



#### **OPM: Achieved Business Objective**

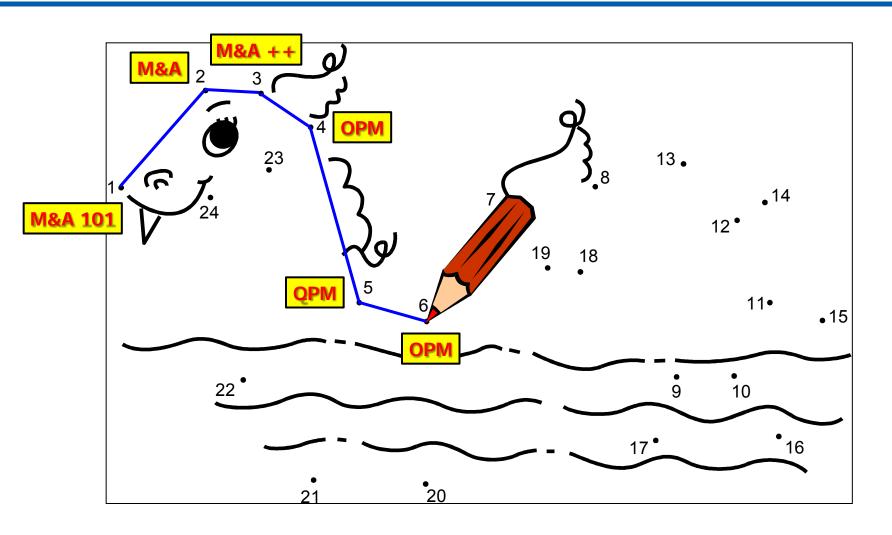
- By age 21 (1980), went from \$4.50/hr to \$13.50/hr (7 graphic art companies)
- Worked 56 hours per week at \$20.25/hr (overtime pay)
- Continued to track and control spending (QPM)
- Significant measureable improvement towards meeting my business objective (OPM)



Bought first house at 22 years old



#### **OPM: Achieved Business Objectives**



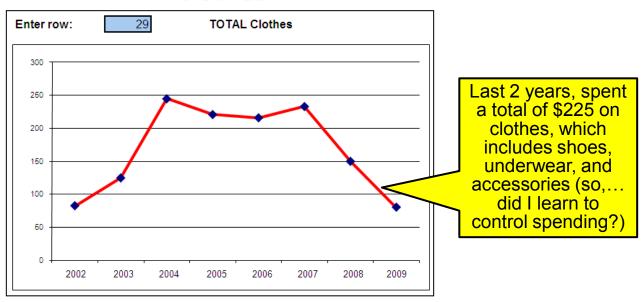
Seeing tangible measurable improvements motivates people.



#### OPP: Evolved to Subprocess-Level Knowledge

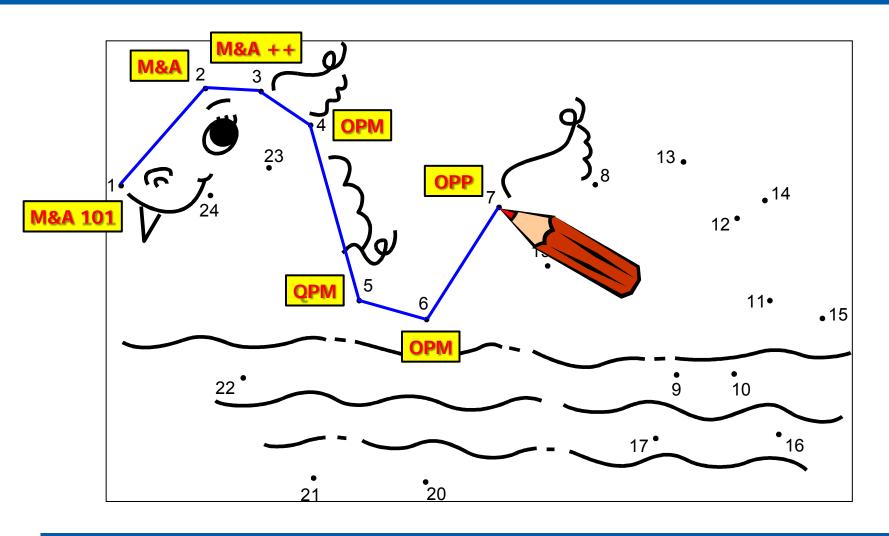
- By 198X, I didn't have enough visibility into spending so I broke the "spending money" process into subprocesses by categories, e.g., food, clothes, entertainment, etc.
- Entered spending into Quicken/Excel to understand typical spending patterns and trends

#### **Clothes**





#### **OPP: Understood Actual Performance**

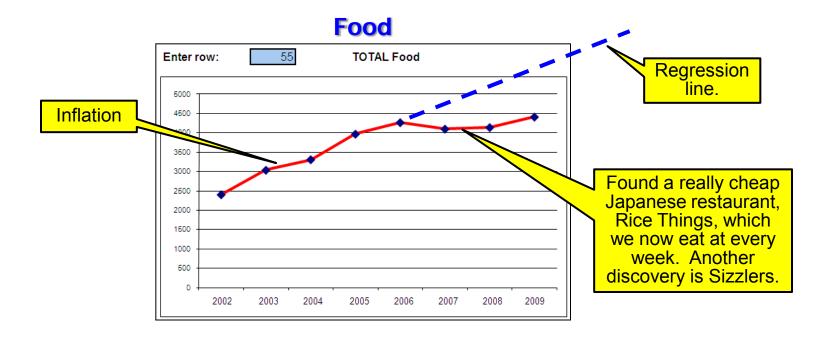


Evolved to understand central tendency and range for subprocesses.



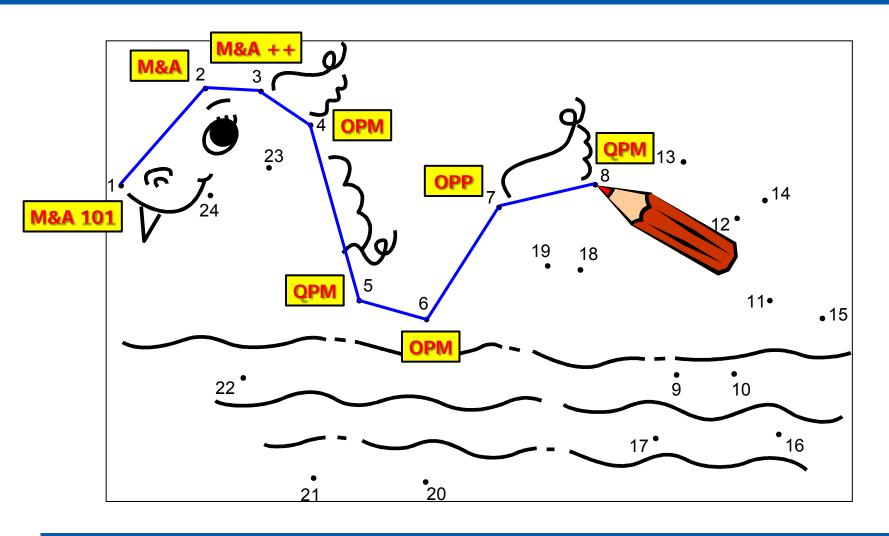
#### QPM: Used Measures to See Improvements

- Used OPP baselines to predict and improve QPM performance
- Understand which expenses I have control over
- Some subprocesses can be controlled through improvements, others cannot





### QPM: Took Action to Meet Objectives



Some process changes have a visible shift. You can alter your future.



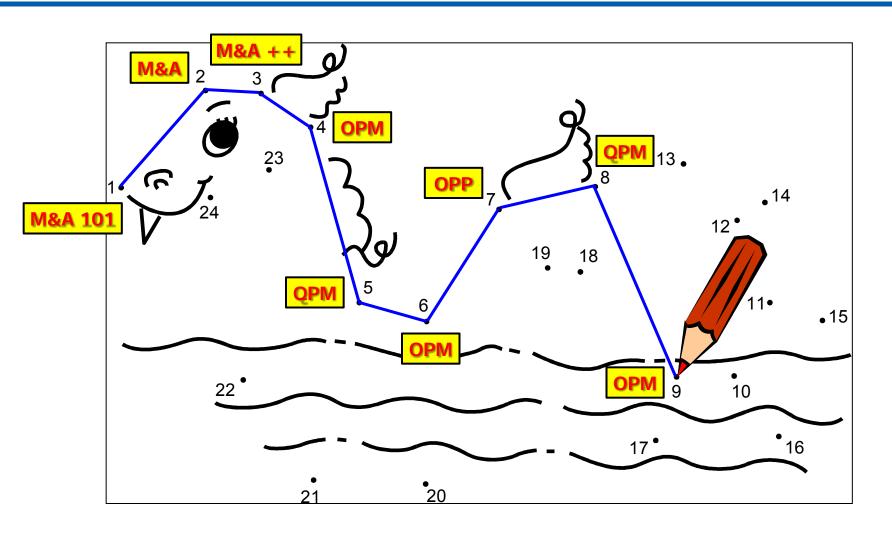
### **OPM: Latest Business Objective**

In 2002, came up with a new business objective,... early retirement at 55





### OPM: Vision to Retire at Age 55



Business objectives should always evolve.

#### **OPP: Created Mortgage Model**

- My husband also has the same business objective to retire at 55.
- He created an OPP mortgage model and did "what-if" analysis.
- He refinanced several times, paid additional principle each month, and at age 49 in 2010, paid off his \$700,000 and \$200,000 homes.

| ©₹ C:\EJW\ | MYMISC\PAYME | NTS.EXE    |             |            |             |            | _ D X    |
|------------|--------------|------------|-------------|------------|-------------|------------|----------|
|            |              | Pay        | ment Estima | ating Syst | em          |            |          |
|            | Loan Am      | ount: 1471 | 48.00       | Term: 12   | 0 months (1 | 0 yrs 0 mo | (2       |
|            | Interes      | t Rate: 4. | 500         | Standard   | Payment: 1  | 525.02     |          |
|            | Stan         | dard Payme | nt          |            | Estimated   | Payment    |          |
| Month      | Principal    | Interest   | Balance     | Payment    | Principal   | Interest   | Balance  |
| 73         | 1274.23      | 250.79     | 65602.32    | 2100.00    | 2027.06     | 72.94      | 17424.54 |
| 74         | 1279.01      | 246.01     | 64323.31    | 2100.00    | 2034.66     | 65.34      | 15389.88 |
| 75         | 1283.81      | 241.21     | 63039.50    | 2100.00    | 2042.29     | 57.71      | 13347.59 |
| 76         | 1288.62      | 236.40     | 61750.88    | 2100.00    | 2049.95     | 50.05      | 11297.65 |
| 77         | 1293.45      | 231.57     | 60457.43    | 2100.00    | 2057.63     | 42.37      | 9240.01  |
| 78         | 1298.30      | 226.72     | 59159.13    | 2100.00    | 2065.35     | 34.65      | 7174.66  |
| 79         | 1303.17      | 221.85     | 57855.95    | 2100.00    | 2073.10     | 26.90      | 5101.57  |
| 80         | 1308.06      | 216.96     | 56547.90    | 2100.00    | 2080.87     | 19.13      | 3020.70  |
| 81         | 1312.96      | 212.05     | 55234.93    | 2100.00    | 2088.67     | 11.33      | 932.03   |
| 82         | 1317.89      | 207.13     | 53917.04    | 935.52     | 932.03      | 3.50       | 0.00     |
| 83         | 1322.83      | 202.19     | 52594.21    | 0.00       | 0.00        | 0.00       | 0.00     |
| 84         | 1327.79      | 197.23     | 51266.42    | 0.00       | 0.00        | 0.00       | 0.00     |
|            | Standard Pay |            |             | Total Es   | timated Pay | ments: 171 | 035.52   |
| Pay-Off    | Time: 120    | mos (10 yr | s 0 mos)    | Pay-Off    | Time: 82 m  | os (6 yrs  | 10 mos>  |
| (New Lo    | ad Save pRi  | nt Forward | Back Amour  | nt Interes | t Payment T | erm Help Q | uit):    |



#### OPP: Created SEI Intro to CMMI Training Model

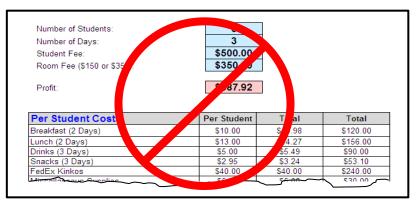
- Part of my retirement plans is to start teaching the SEI Introduction to CMMI-DEV V1.3 course publicly in Los Angeles on the weekends, starting in Jan 2011.
- Built a model for "what if" analysis for teaching.

| Number of Students:                                     | 6                            |                              |                                 |
|---|------------------------------|------------------------------|---------------------------------|
| Number of Days:   | 3                            |                              |                                 |
| Student Fee:  | \$500.00                     |                              |                                 |
| Room Fee (\$150 or \$350):                              | \$350.00                     |                              |                                 |
| Profit:   | \$887.92                     |                              |                                 |
|   |                              |                              |                                 |
| Per Student Costs                                       | Per Student                  | Total                        | Total                           |
| Per Student Costs Breakfast (2 Days)                    | Per Student<br>\$10.00       | <b>Total</b><br>\$10.98      | Total<br>\$120.00               |
|   |                              |                              |                                 |
| Breakfast (2 Days)                                      | \$10.00                      | \$10.98                      | \$120.00                        |
| Breakfast (2 Days)<br>Lunch (2 Days)                    | \$10.00<br>\$13.00           | \$10.98<br>\$14.27           | \$120.00<br>\$156.00            |
| Breakfast (2 Days)<br>Lunch (2 Days)<br>Drinks (3 Days) | \$10.00<br>\$13.00<br>\$5.00 | \$10.98<br>\$14.27<br>\$5.49 | \$120.00<br>\$156.00<br>\$90.00 |



#### OPP: Use Models Regardless if They are CMMI Compliant

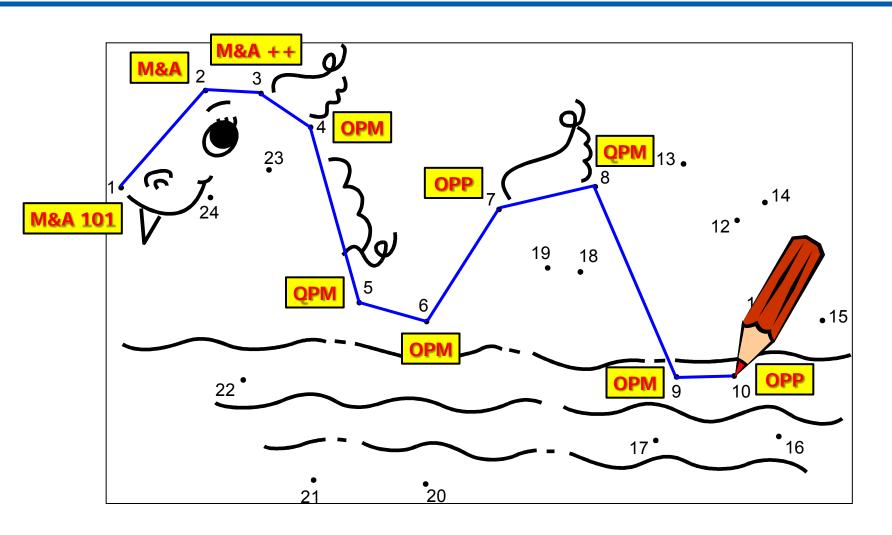




- Academics will say BAD DIANE, those models didn't use historical data so they are no good !!!
- If a model helps you make better decisions towards meeting your business objectives, that's all that should matter.



#### **OPP: Created OPP Models**

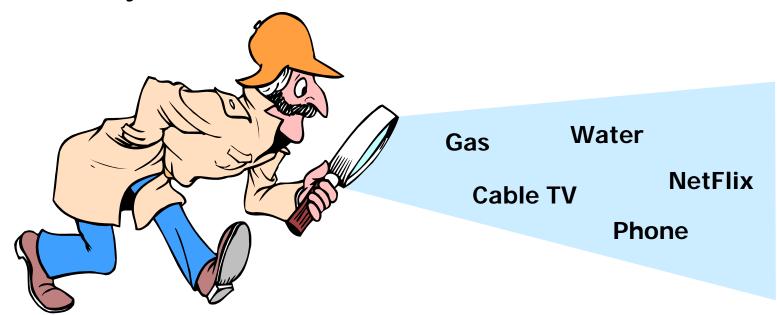


"All models are wrong, but some are useful", George Box



## CAR: What's Still Wrong With My Spending

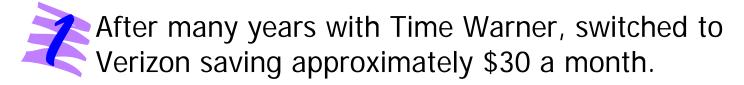
- Problem was I still wasn't happy with my spending, but didn't know how to fix it
- In 2010, decided to do a CAR, and analyze spending in more detail, and figure out the root cause of some wasteful spending
- Analyzed the utilities subprocess baseline (OPP), which had been ignored for years to see if there was waste.



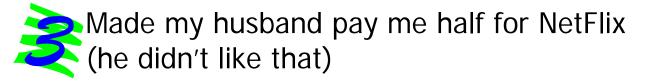


#### CAR: Spending Improvements per CAR Analysis

CAR identified 3 corrective actions:



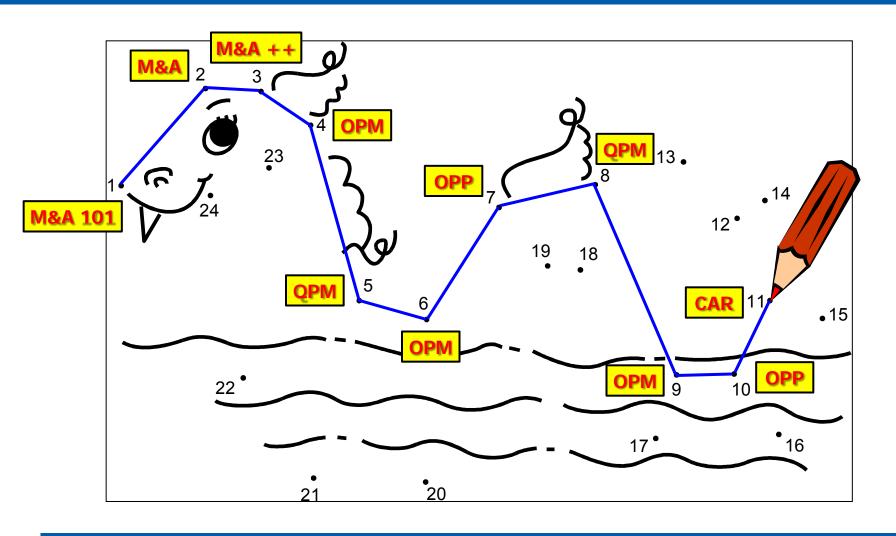




 CAR analysis, coupled with 3 fixes, helped my QPM objectives which was to control spending



#### **CAR: Fixed Utilities Problem**



Use CAR when you know it's broken but don't know why.



#### OPM: Where Are We Now for Retiring at 55?

After paying off both homes in 2010, my husband bought our retirement home in the mountains of Los Angeles at 3.5% interest, 0 points, on 1 acre at age 49. Escrow will close Nov 24, 2010.





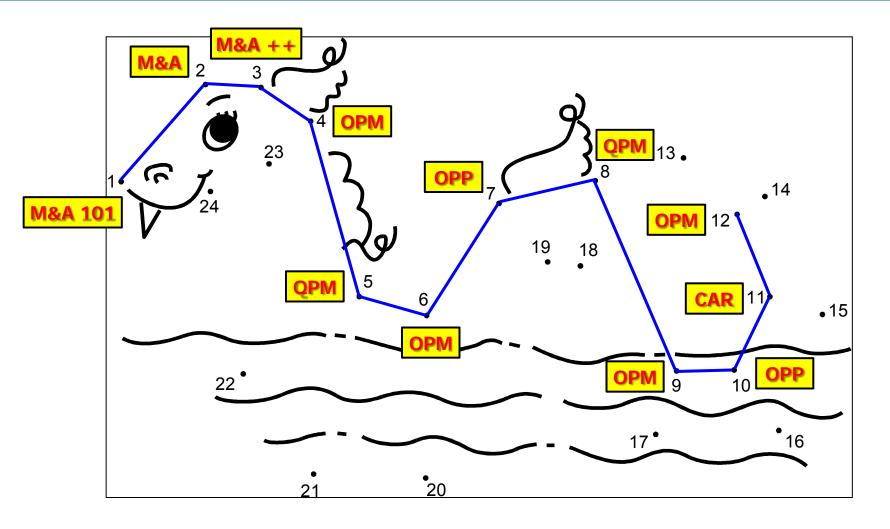
### Why All the Bragging?

Because I want you to beat me up in the parking lot so I finally get time off from work.



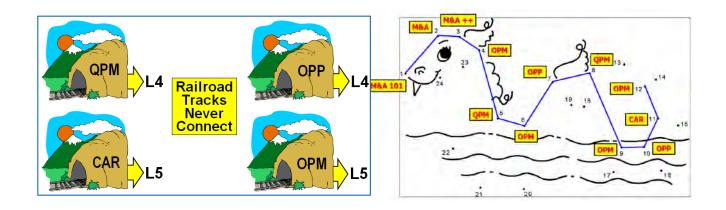
Seriously,... it's because for people/projects to be successful, high maturity behavior needs to be institutionalized, i.e., a part of your day-to-day life.

#### OPM: On Schedule to Achieve Business Objectives

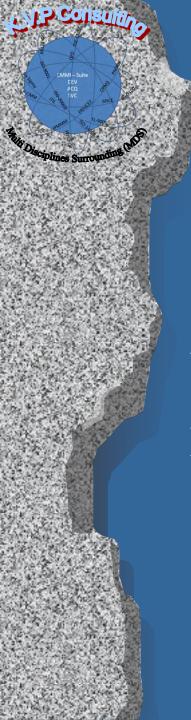


High maturity is continuing to help us meet our "business objectives".

#### Summary



- High maturity process areas are not isolated tunnels.
- High maturity organizations continually use all 4 process areas. They
  do not say, "QPM and CAR" are not mine,... that's only for projects, or
  "OPP and OPM" are not mine, that's only for organizations. They see
  value in using all 4 process areas.
- This presentation shows how much you could use high maturity concepts, even in your personal lives, to be more successful.



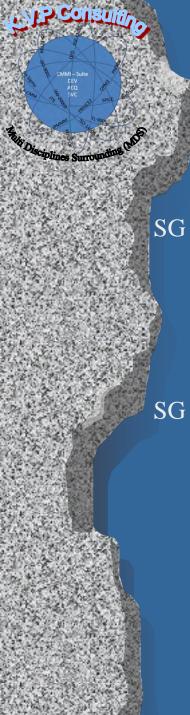
# The Issue of Performance Why Do you need a Maturity Level 5

Achieving the Organizational Business
Objectives Through Optimized Operational
Processes



#### CMMI ML 4 & 5 PAs Recap

- Quantitative Project Management
- Organizational Process Performance
- Causal Analysis and Resolution
- Organizational Innovation and Deployment



#### Specific Practices of QPM

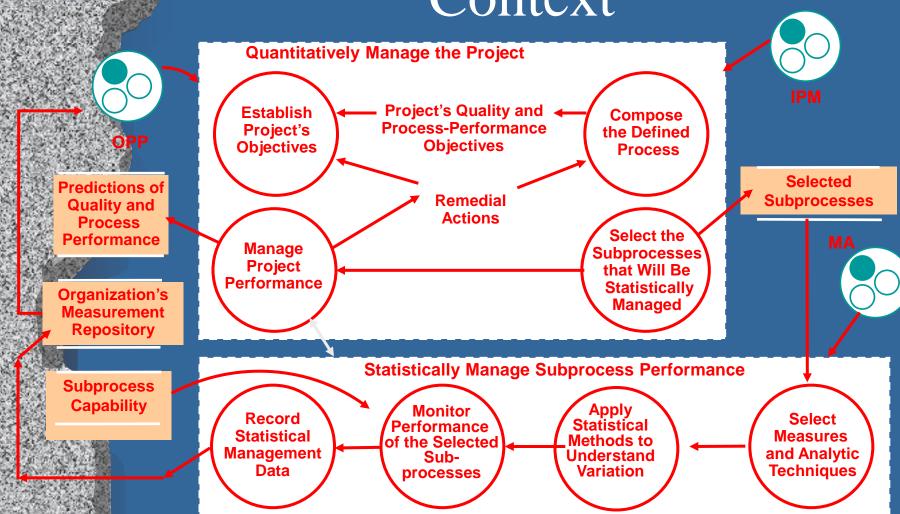
SG 1 Quantitatively Manage the Project

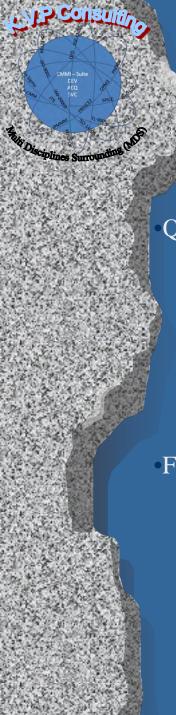
- SP 1.1 Establish the Project's Objectives
- SP 1.2 Compose the Defined Process
- SP 1.3 Select the Subprocesses That Will Be Statistically Managed
- SP 1.4 Manage Project Performance

SG 2 Statistically Manage Subprocess Performance

- SP 2.1 Select Measures and Analytic Techniques
- SP 2.2 Apply Statistical Methods to Understand Variation
- SP 2.3 Monitor Performance of the Selected Subprocesses
- SP 2.4 Record Statistical Management Data

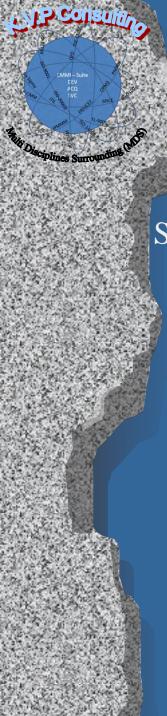
## Quantitative Project Management Context





#### **QPM Summary**

- QPM involves both quantitative and statistical management. The project
  - establishes quantitative objectives based on the organization's business objectives and needs of the customer
  - composes a defined process based on historical capability data that will help it meet those objectives
  - monitors the project quantitatively to assess whether the project is on course to achieve its objectives.
- •For each subprocess to be statistically managed,
  - objectives are established for its process performance
  - its variation is understood (subprocess is stable)
  - when the subprocess fails to achieve its objectives, corrective action is taken



#### Specific Practices of OPP

SG 1 Establish Performance Baselines and Models

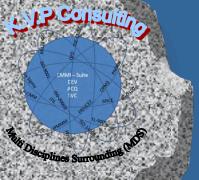
SP 1.1 Select Processes

SP 1.2 Establish Process-Performance Measures

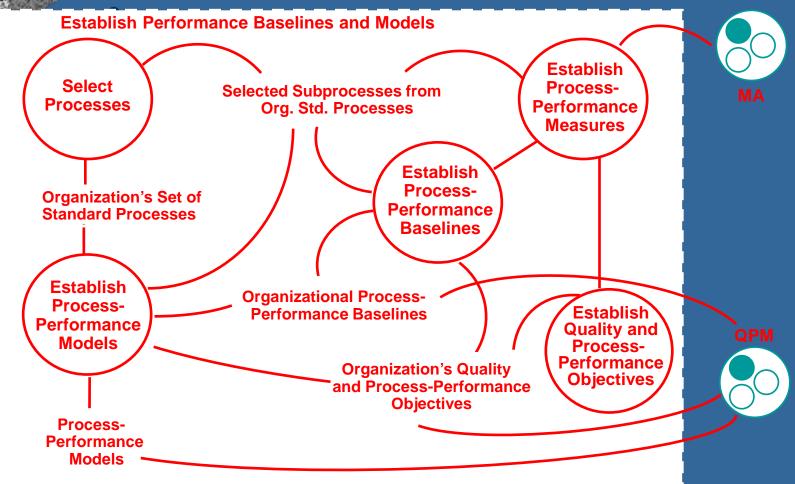
SP 1.3 Establish Quality and Process-Performance Objectives

SP 1.4 Establish Process-Performance Baselines

SP 1.5 Establish Process-Performance Models



## Organizational Process Performance Context

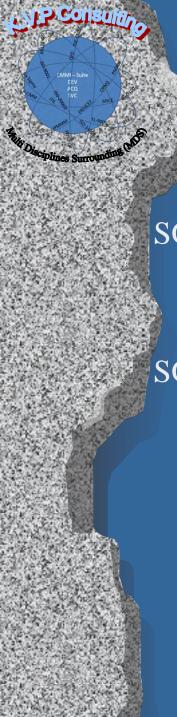




### **OPP Summary**

•The first three SPs establish processes (subprocesses), measures, and objectives at the organization level that focus and align the quantitative management activities of projects (QPM) with the business objectives of the organization.

•The last two SPs take the actual results obtained from projects to create baselines and models that enable the next project to predict what performance to expect from selecting certain subprocesses for its use, and thereby assess its ability to meet its objectives.



#### Specific Practices of CAR

SG 1 Determine Causes of Defects

SP 1.1 Select Defect Data for Analysis

SP 1.2 Analyze Causes

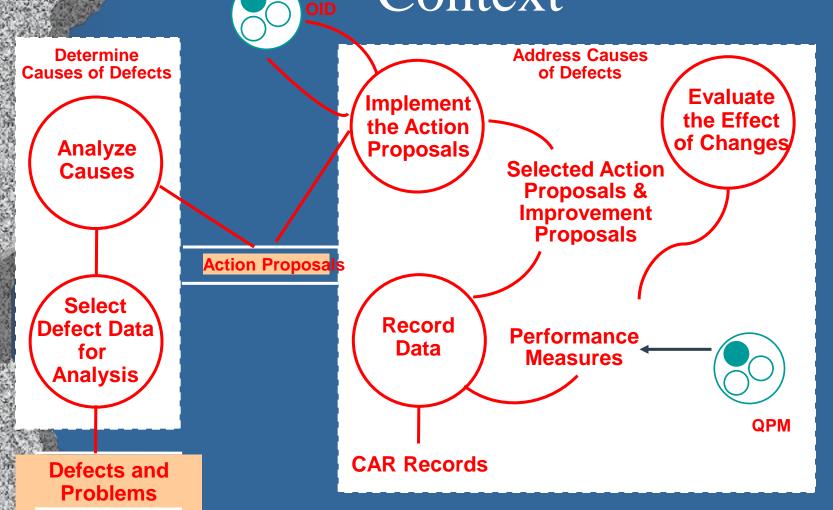
SG 2 Address Causes of Defects

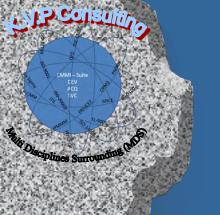
SP 2.1 Implement the Action Proposals

SP 2.2 Evaluate the Effect of Changes

SP 3.2 Record Data

## Causal Analysis and Resolution Context





#### CAR Summary

•CAR has its greatest value when performed in the context of a quantitatively managed process.

#### CAR involves

- a selection of defects or problems whose resolution would benefit the organization
- a root cause analysis
- development and implementation of an action plan to remove the root causes of the defects or problems



#### Specific Practices of OID

#### SG 1 Select Improvements

SP 1.1 Collect and Analyze Improvement Proposals

SP 1.2 Identify and Analyze Innovations

SP 1.3 Pilot Improvements

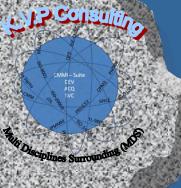
SP 1.4 Select Improvements for Deployment

SG 2 Deploy Improvements

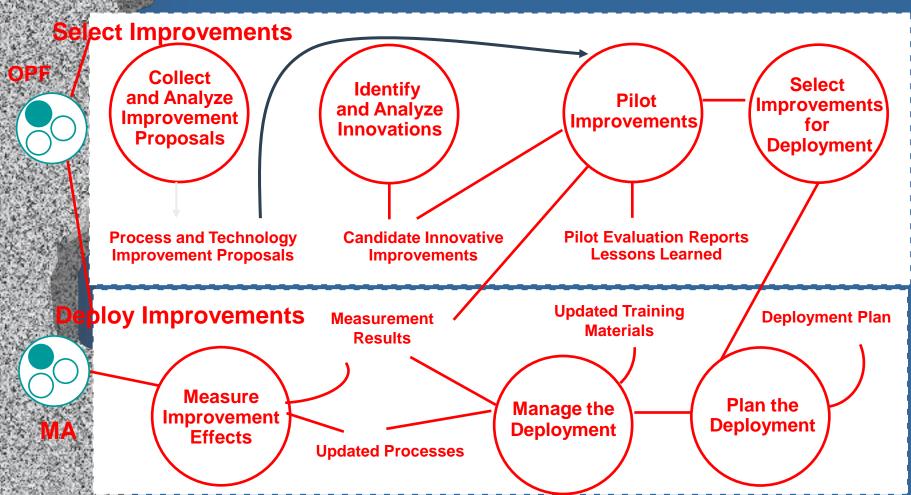
SP 2.1 Plan the Deployment

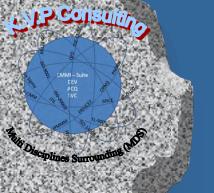
SP 2.2 Manage the Deployment

SP 2.3 Measure Improvement Effects



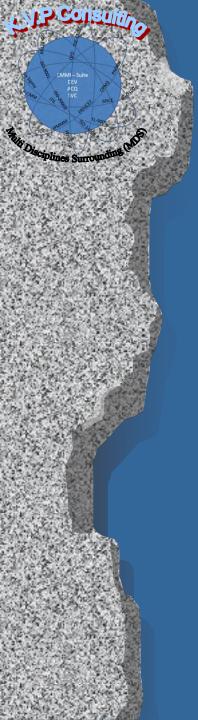
## Organizational Innovation and Deployment Context





### OID Summary

- OID uses the quantitative information developed at ML4 to identify, analyze, and select incremental and innovative improvements to the organization's processes and technologies.
- •OID involves both incremental improvement (everyone in the organization is involved) and revolutionary improvements (outward looking and opportunistic) to targeted processes.
- •Improvements are introduced systematically in the organization by conducting pilots, analyzing costs and benefits, and planning and managing deployment.
- •OID embodies continuous improvement that results from implementing all the PAs in the model.

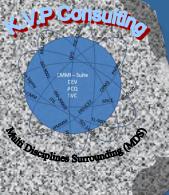


The Theory in the Model is Nice

#### However

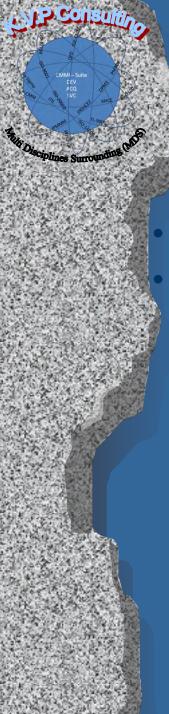
Real Life is More Complicated

**Much More** 



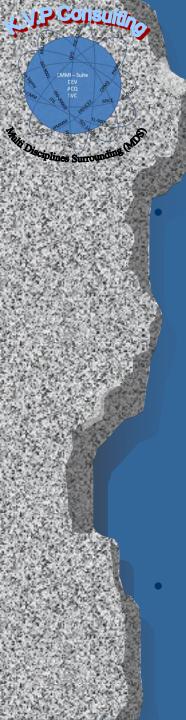
### Considerations for Optimization

- Optimization is successful when the cost of manufacturing will drop and your profit will increase
- Produce high-quality products within shorter time lines
- To Correct balance between time and cost *versus* yield and quality is essential to maximize return on investment



### Considerations for Optimization

- Demonstration of the scalability
- Partial selection of what to optimize
  - Material
  - Cost of product
  - Design for
    - Scalability
    - Availability
    - Reliability
    - Serviceability
    - Maintainability
    - Supportability
    - Stability
    - Reusability
  - Sustainability of the Technology as a solution

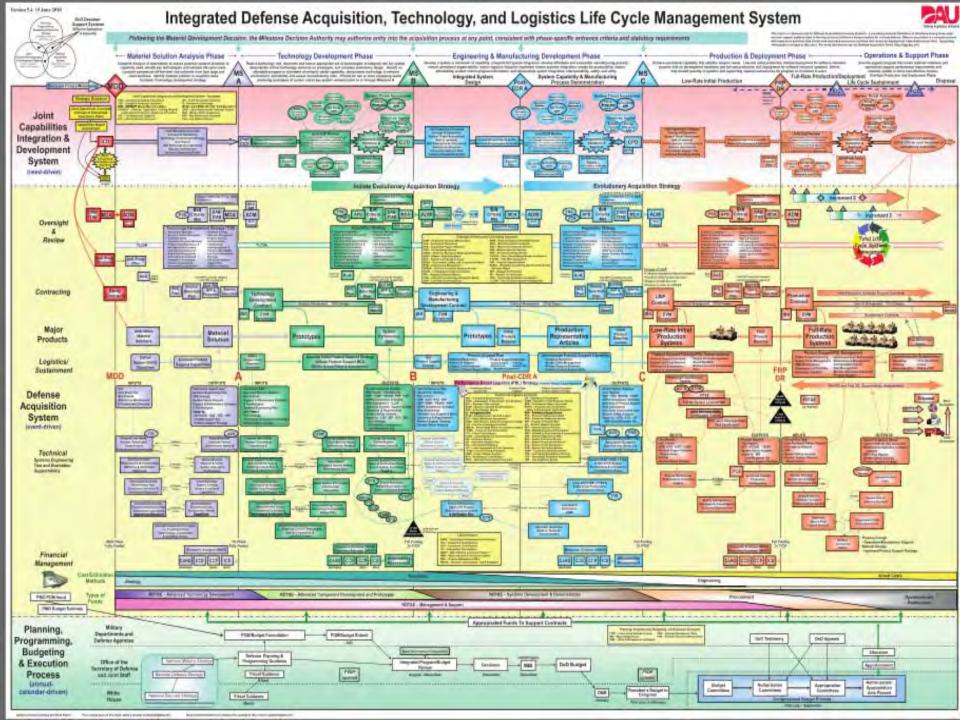


## Main Steps for High Maturity Process Improvement

During our analysis and planning, we were able to identify improvement targets in main lifecycle areas such as

- operations,
- information,
- governance,
- people
- organizational structure,
- portfolios,
- project execution,
- finance.

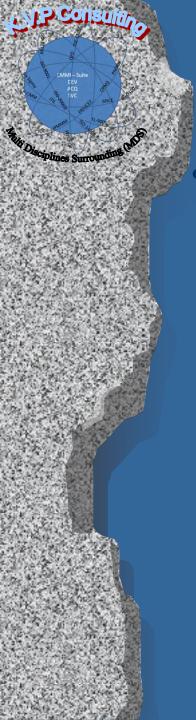
And as in core process that are critical to the system success such as stakeholder management, technical interfaces and integration.





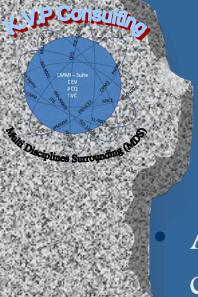
As the result of this observation we have built an action plan,

- Then in the second step we have built a interfaces map using the lifecycle model, which enable us to begin the improvement journey, and manage the transformation to higher maturity by building on each successive step, and ultimately delivering the benefits expected:
  - reuse
  - improved compatibility and quality
  - response time
  - interoperability
  - business agility.
- Process performance and its impact on the organization governance is a significant part of that journey



#### Case Studies

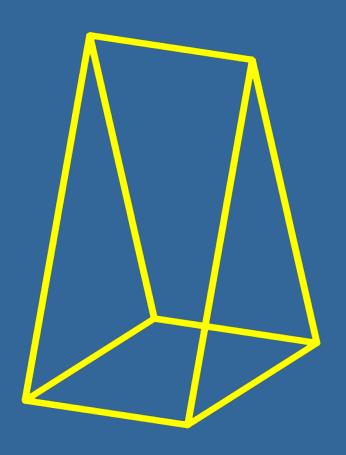
- Process Optimization (Brief Walkthrough)
- Product Optimization (Brief Walkthrough)
- Product Optimization Which Leads to Process Optimization (Detailed Walkthrough)

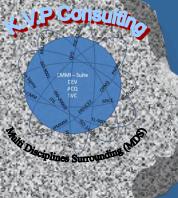


### Suggested Measures

Planned and Managed Process

- Availability and completeness of plan
- Plan for resource
- Overall performing time
- Omissions in performance
- Compliance to plan

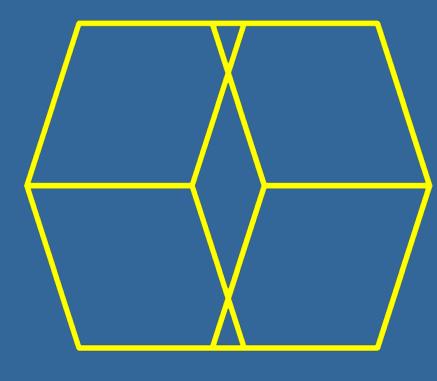




#### Process Levels and Dimensions

Architected and Improved Process

- Objectives
- Structured
- Monitored / Measured
- Effective / Efficient
- Process Interfaces and Integration in Lifecycle
- Prioritize and Balance
  Resource Utilization
  within Larger Context

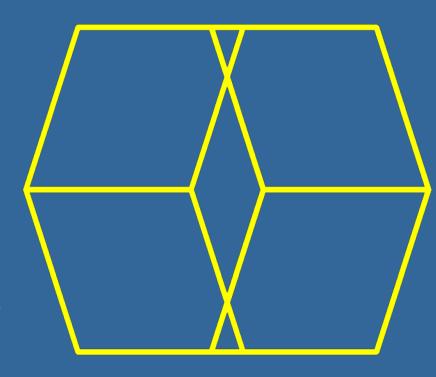




### Suggested Measures

#### Architected and Improved Process

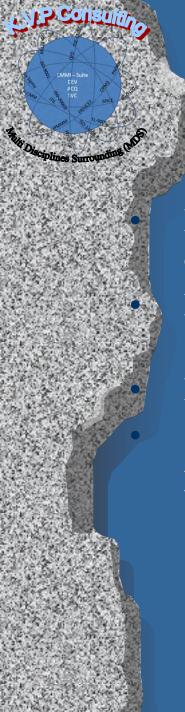
- Process productivity
- Process resourcesutilization effectiveness
  - Process resources utilization efficiency
  - Meeting the process objectives
- Other processes interfaces efficiency
- Process related defects density



### Process Levels and Dimensions **Operationally Optimized Process** Known Capability and Stable **Defined Ingredients Known Critical Elements** Meeting Objectives Controlled Interfaces Responsive / Modifiable Resilience / "Agile" Relevant 'What If's Scenarios

Boundaries
Predictable Outcomes

Accepted Tolerance / Freedom

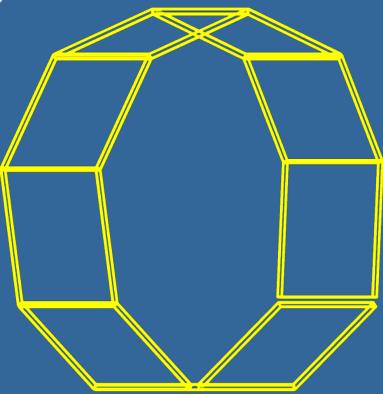


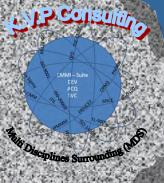
## Suggested Measures Operationally Optimized Process

Influence of Critical Elements on process output

Process resources utilization 'What If's Scenarios
Process elements capability

Quantitative definition of process ingredients





#### Product Levels and Dimensions

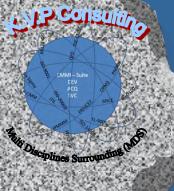
- Planned and Managed System
- Architected and Engineered System
- Operationally Operated and Optimized System



## Suggested Measures Planned and Managed System

- Requirements Status
- Change Request Status
  - Component Status
- Increment Content Components
- Increment Content Functions
- Technical Performance
- Standards Compliance
- Requests for Support
- Support Time Requirements

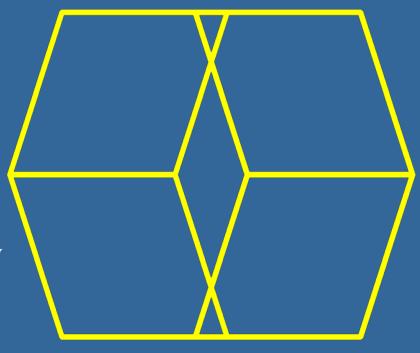




#### Product Levels and Dimensions

Architected and Engineered System

- Operational Needs and Scenarios
- System Architecture
- System Interfaces and Integration
- Validity / Verifiability
- Compliance with CONOPS

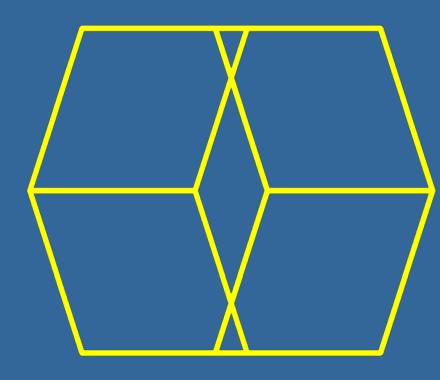




### Suggested Measures

#### Architected and Engineered System

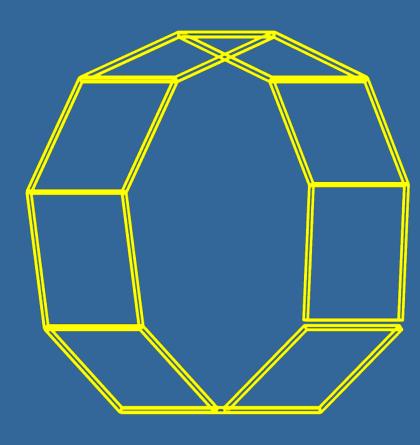
- Maintenance Actions
- Technical Performance
  - Performance Rating
- Requirements Coverage
- Defect Containment
- Utilization
- Reuse level
- Interfaces performance
  - Validation accuracy

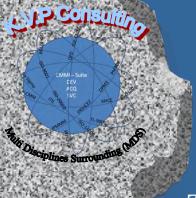




Operationally Optimized System

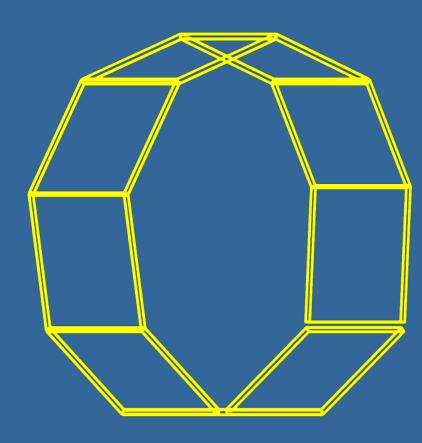
- Scalability
- Availability
- Reliability
- Serviceability
- Maintainability
- Supportability
- Stability
- Reusability
- Soundness of Technology Future

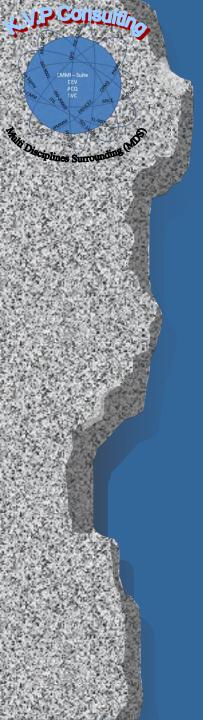




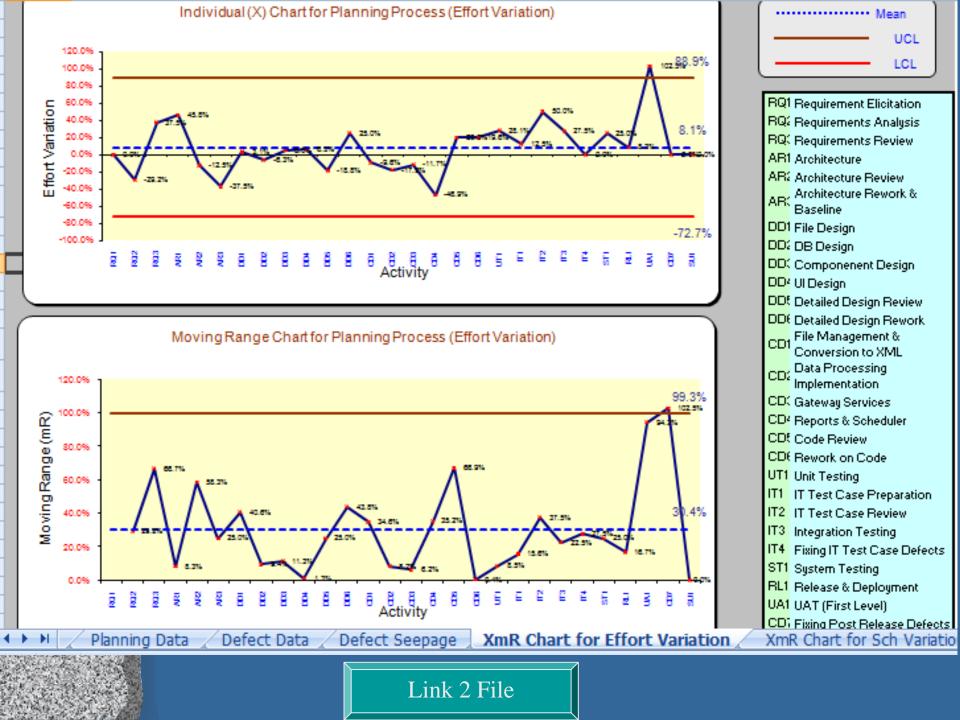
## Suggested Measures Operationally Optimized System

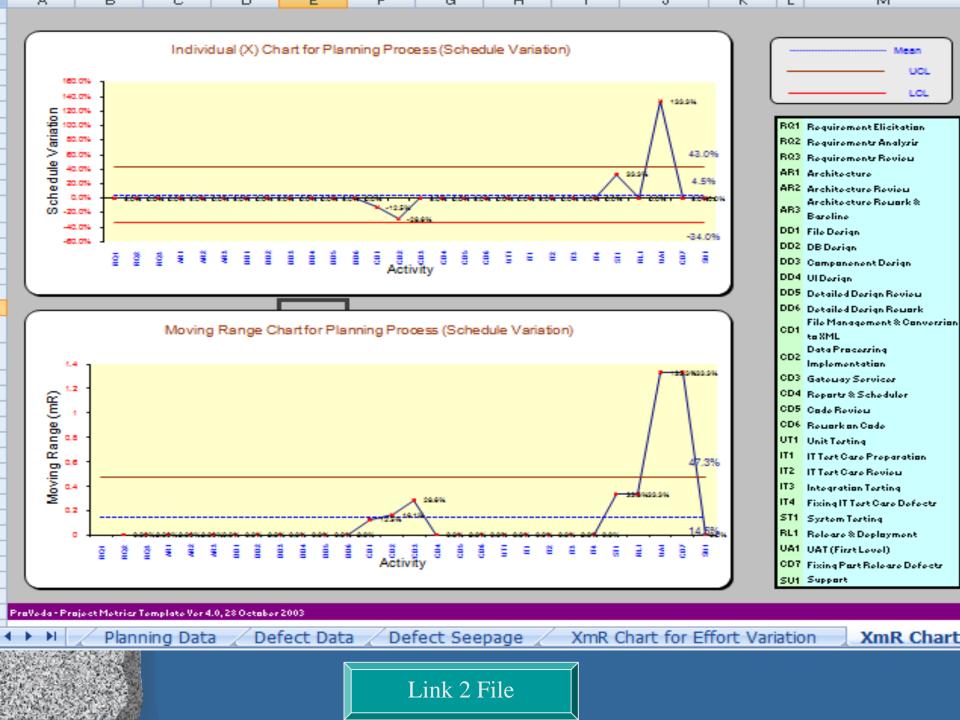
- Technology flexibility
- Capacity growth models
- System (size) growth models
- Time to Restore
- Down time
- MTBF
- Support calls causes and density
- Technology extendibility



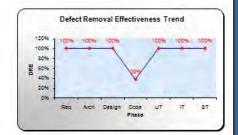


### Case studies

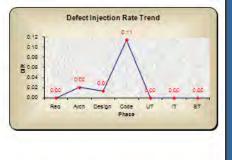






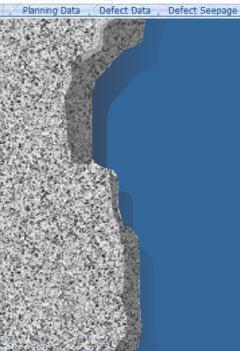


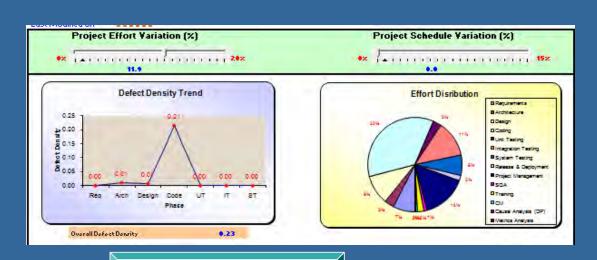




XmR Chart for Effort Variation

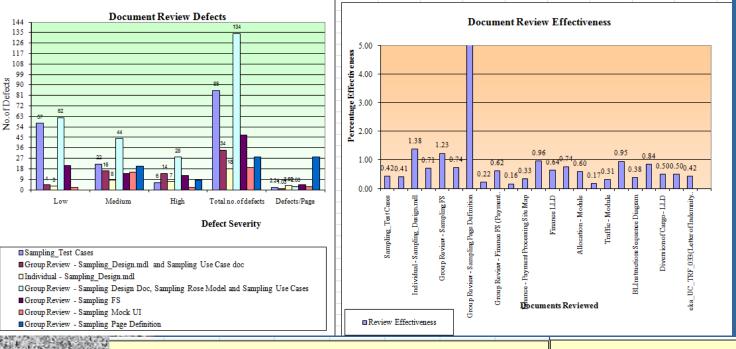
| Defect Seepage Table Data          |   |             |       |        |        | Last modified on |         | 02-Sep-08 |
|------------------------------------|---|-------------|-------|--------|--------|------------------|---------|-----------|
| Activity                           | Defects (shaded cells MUST NOT contain entries) |             |       |        |        |                  |         |           |
|                                    | Total   | Deliverable |       |        |        |                  |         |           |
|                                    |   | Req         | Arch  | Design | Code   | UT               | П       | ST        |
| Total                              | 63  | 0           | 3     | 2      | 58     | 0                | 0       | 0         |
|                                    |   |             |       |        |        |                  |         |           |
| Defect Distribution                |   | 0.00%       | 4.76% | 3.17%  | 92.06% | 0.00%            | 0.00%   | 0.00%     |
|                                    |   |             |       |        |        |                  |         |           |
| Defect Density                     | 0.23  | 0.00        | 0.01  | 0.01   | 0.21   | 0.00             | 0.00    | 0.00      |
|                                    |   |             |       |        |        |                  |         |           |
| Defect Removal                     |   | 100%        | 100%  | 100%   | 38%    | 100%             | 100%    | 100%      |
| Effectiveness (DRE)                |   |             |       |        |        |                  |         |           |
| Dhara Cantalanant                  |   |             |       |        |        |                  |         |           |
| Phase Containment<br>Effectiveness |   | 0.00%       | 4.76% | 7.94%  | 42.86% | 42.86%           | 100.00% | 100.00%   |
| Ellectivelless                     |   |             |       |        |        |                  |         |           |
|                                    |   |             |       |        |        |                  |         |           |
| Review Effectiveness               | 42.86%  |             |       |        |        |                  |         |           |
|                                    |   |             |       |        |        |                  |         |           |
| T4' F#4'                           | E7 4 40/  |             |       |        |        |                  |         |           |
| Testing Effectiveness              | 57.14%  |             |       |        |        |                  |         |           |
|                                    |   |             |       |        |        |                  |         |           |
| Defect Injection Rate              |   | 0.00        | 0.02  | 0.01   | 0.11   | 0.00             | 0.00    | 0.00      |

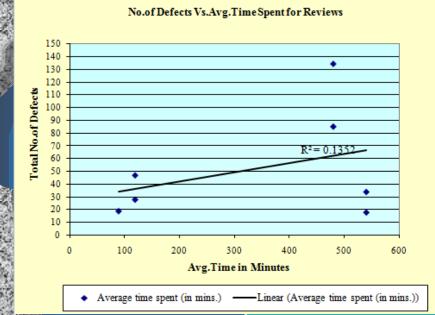


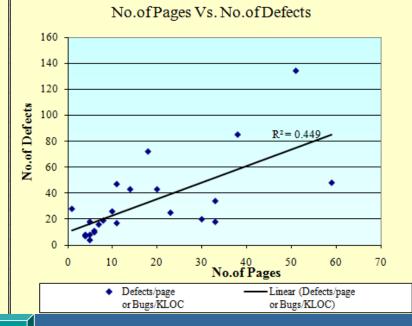


Link 2 File

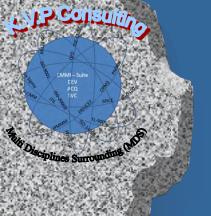
XmR Chart







Link 2 File



# Questions

Performance Effects of Measurement and Analysis: Project, Product and High Maturity

James McCurley
Dennis R. Goldenson

CMMI Technology Conference & User Group Denver, Colorado – November 2010

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# Today's Talk

# Scope of the presentation

More results from the 2009 high maturity survey in the SEI's series of measurement & analysis state-of-the-practice sample surveys

- Surveys of appraised organizations in 2008 & high maturity lead appraisers (HMLAs) in 2009
  - Great deal of consistency in replies & statistical relationships
  - Based on perspectives of two groups that are often thought to be quite different
- Focus here today on results linking process performance modeling to success in achieving organizations' appraised high maturity level goals

Summary, lessons learned & next steps

### Why is This Work Important?

Confusion still exists about what is necessary to meet the high maturity goals of CMMI based process improvement

 & the value of improving measurement capability often isn't appreciated in lower maturity organizations

We need more & better measured evidence about the quality & performance outcomes that are possible with CMMI-based process improvement

- Especially in these times of limited resources & increasing skepticism
- Without such evidence continued support for CMMI is at increasing risk

#### The Wider Body of Work

#### In depth studies

- SEI's series of workshops on measurement & analysis activities in high maturity organizations
  - In-depth presentations by leaders in the field: 5 workshops over 3 years
  - Focused initially on value added by CMMI-based process performance modeling
  - Detailed discussions of modeling methods & results
  - Additional collaboration within & across organizations
  - (References & URLs are at the end of this presentation)
- Similar work ongoing through SEI Partner Network working group of leading HMLAs

Wider publication of results

Additional workshops & colloquia (TBD)

Other ideas?

Let's talk later!

#### Sample Surveys

#### Measurement & analysis state-of-the-practice series since 2006

- & occasionally since 1990
- A basis for more broadly based comparisons across programs & organizations
- Focus on value added by CMMI process performance modeling since 2007
  - As it varies with the extent of use & understanding of PPMs
  - Along with other aspects of measurement & analytical practices
  - As well as organizational resources & management support
  - 2009 response rate: 55%

#### A little about validity & generalizability of sample surveys...

- Candid replies recognizing:
  - ... (Particularly seen in open-ended text responses) ...
  - Weak points & need for improvement
  - Backsliding over time
  - Failure to achieve appraisal goals
- Consistent covariation with performance outcomes
  - Business value
  - Achieved maturity levels

# Today's Talk

#### Scope of the presentation

# More results from the 2009 high maturity survey in the SEI's series of measurement & analysis state-of-the-practice sample surveys

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  - Great deal of consistency in replies & statistical relationships
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Summary, lessons learned & next steps

# How do the Samples differ?

To review from last year...

2008: Sponsors of organizations appraised at maturity level 4 & 5

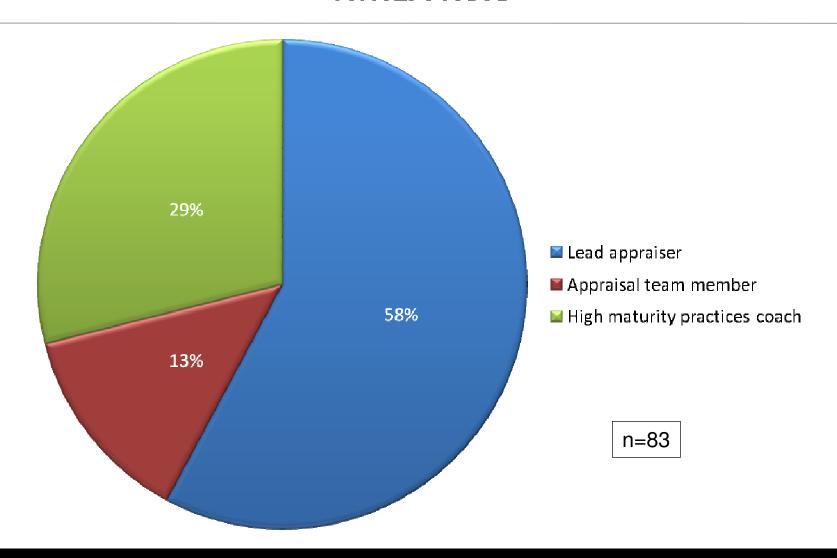
2009: HMLAs asked to answer from perspective of organizational units

- With which they worked & were most recently appraised for CMMI-based high maturity status
- As lead appraisers, appraisal team members, or in a coaching capacity

Still a relatively small number of HMLAs with direct experience at time of 2009 survey

- Realized sample would include HMLA replies about organizations that did not achieve appraised high maturity goals
- Useful to better understand HMLA reports about use & value added by analytical approaches & methods used for process performance modeling among organizations seeking appraised high maturity status

#### **HMLA** Role



### The Survey Data Do Not Speak for Themselves

#### Perceptions & expectations often differ among survey respondents

- & they probably do by maturity level
- e.g., standards about how much is enough to justify a positive answer

#### We're not claiming cause & effect

- It's statistical association at one point in time
- Cause & effect often are recursively reciprocal over time
- Keep this in mind as we review the evidence!

#### Results described more fully in two SEI technical reports

- CMU/SEI-2008-TR-024
- CMU/SEI-2010-TR-022
- (References & URLs are at the end of this presentation)

### Comparable Organization Scope in Both Years

#### Similar organizational context in the 2008 and 2009 high maturity surveys

- Sector (commercial, contracted new development, in-house or proprietary development or maintenance, defense contractors, other government contractors, DoD or military organizations)
- Focus (product or system development, maintenance or sustainment, acquisition, service provision)
- Engineering discipline (software, systems, hardware, design, test)
- Number of FTE software, hardware or systems engineering employees

#### They do differ somewhat by country

- More from China & relatively fewer from India
- Possibly since the 2009 engagements are more recent

# **Synopsis & Implications**

As noted last year: Overall results from HMLAs in 2009 are consistent with reports from HM appraisal sponsors in the 2008 survey

Considerable understanding & use of process performance models (PPMs) is evident in both surveys

Judgments about value added by process performance modeling also vary predictably along with variation in:

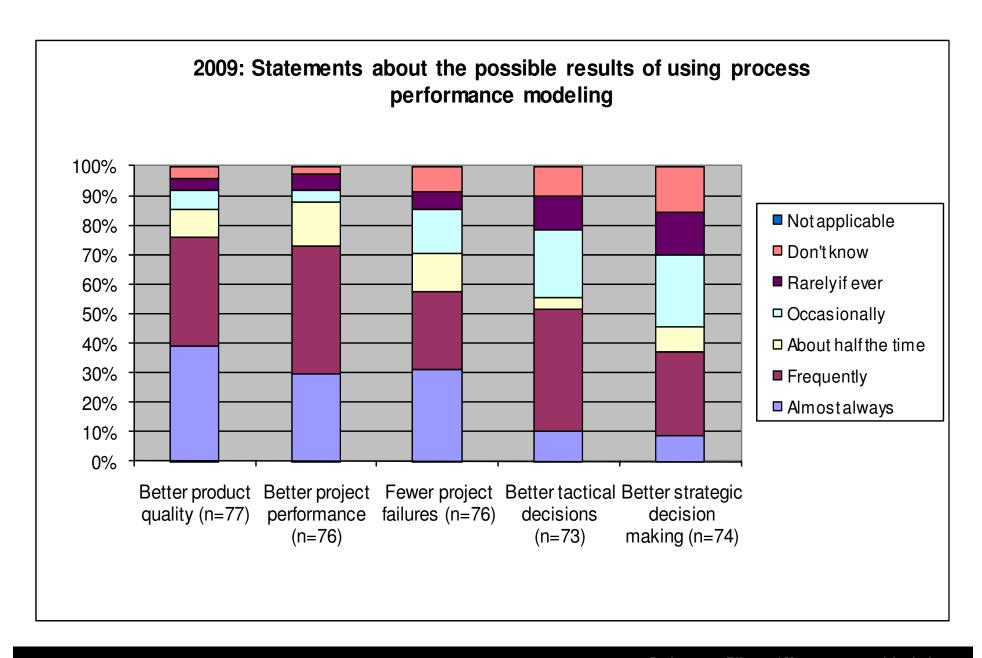
- Understanding & reported use of process performance models
- Use of various analytical methods & management processes

Whether or not the organizations achieved their appraised high maturity goals also varies predictably for the same reasons

We hope to see how & if high maturity organization sponsor perspectives continue to mirror those of HMLAs in future surveys

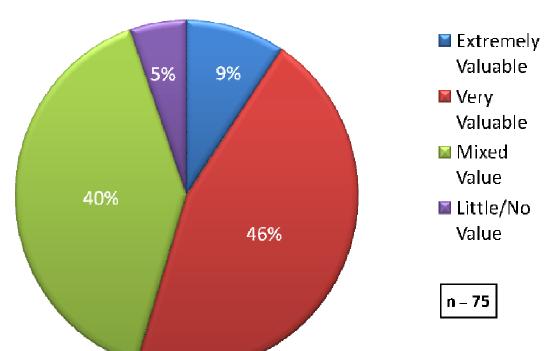
With respect to increasing use of analytical techniques to inform decision-making

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#### **Overall Value of PPMs**

# In your best judgment, how useful have process performance models been for this organization overall?



Extremely valuable: they rely on them extensively

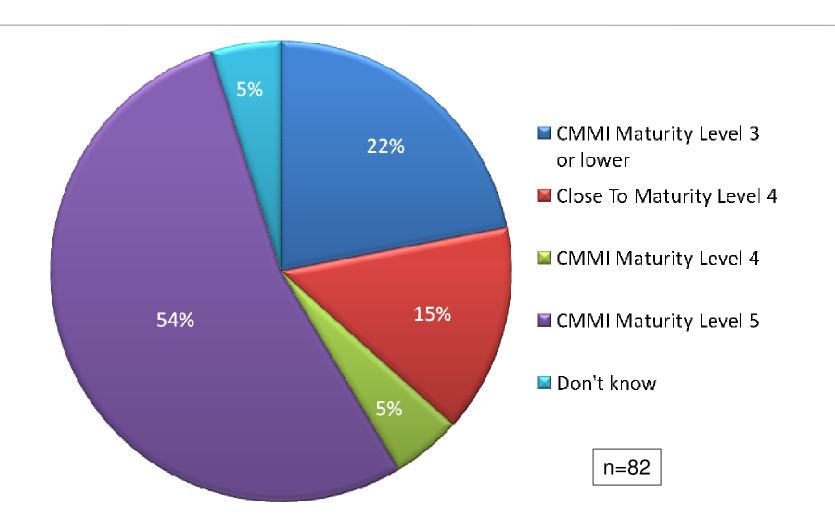
Very valuable: they have obtained much useful information from them

Mixed value: they have obtained useful information on occasion

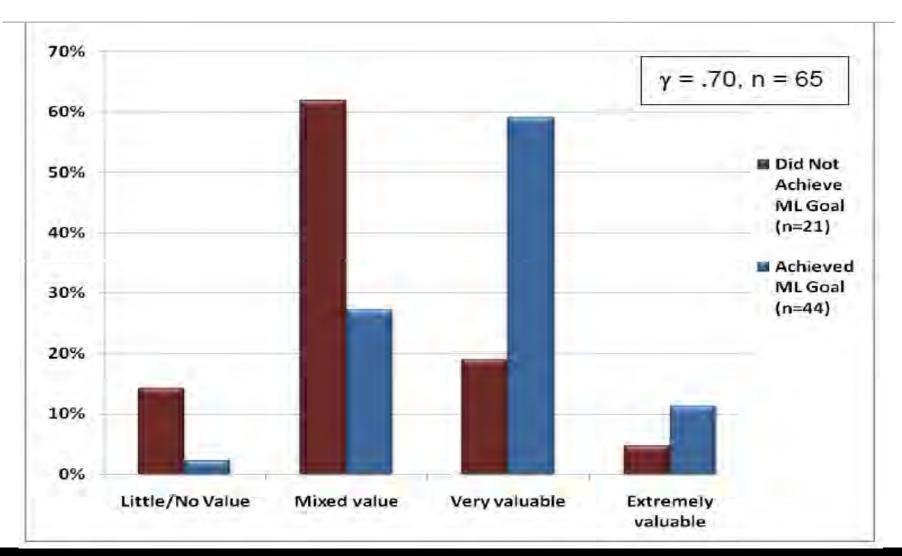
Little or no value

It's been harmful, not helpful

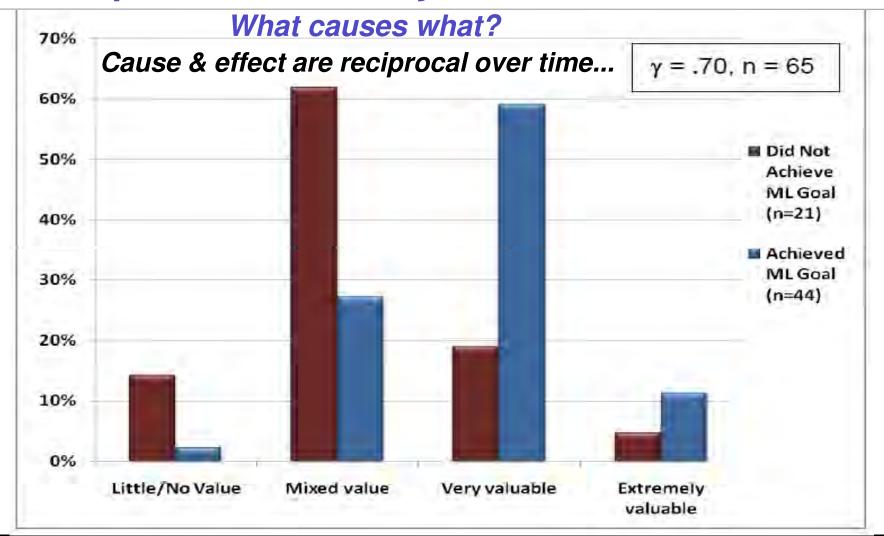
### **Achieved Maturity Level Varies Too**



# The Two are Closely Related



# This may be the most important graphic in the whole presentation. Why?



#### The Chicken or the Egg?

Cause & effect may be reciprocal over time

But it doesn't matter which comes first!

Organizations that find value in their PPMs are more likely to achieve their HM goals

But achieving HM status also affects the likelihood that organizations will find additional value in creating & using an enhanced suite of PPMs

 Achieving HM status also affects the use of related analytical methods & model results to inform business and technical decision making

Some organizations undoubtedly have implemented processes that are consonant with CMMI best practices for other reasons

Especially early adopters of CMMI

But the fact of the matter is that they *are* CMMI best practices.

# **Selected Relationships**

Not surprisingly: Strength of relationships with a wide variety of factors are often similar for both:

- Overall value attributed by HMLAs to use of process performance modeling
- Whether or not the organizations achieved their appraised high maturity level goals

#### They both vary predictably with:

- Understanding & reported use of process performance models
- Use of various analytical methods & management processes

See the TR & last year's presentation for more detail about overall value...

(References & URLs are at the end of this presentation)

#### What follows here?

- The strongest relationships with achievement of high maturity level goals
- Highlighting instances where strength of those relationships differ from comparable relationships with overall value

### **Healthy PPM Ingredients: Emphasis**

How much emphasis does the organization place upon the following in its process performance modeling?

- Accounting for uncertainty and variability in predictive factors and predicted outcomes
- Factors that are under management or technical control
- Other product, contractual or organizational characteristics, resources or constraints
- Segmenting or otherwise accounting for uncontrollable factors
- Factors that are tied to detailed subprocesses
- Factors that are tied to larger, more broadly defined organizational processes

Note that values on the extremes of this & all other weighted sum measures require consistency of replies across all of the component sub questions

### **Survey Composite Variables**

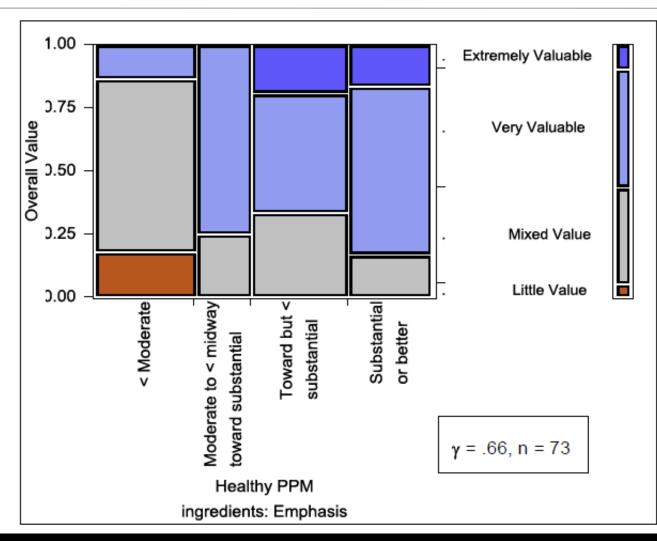
Many of the relationships described here use composite measures that are based on combinations of several related component questions. Each composite measures is based on the appraisers' answers to a group of related questions. The possible answers to those questions are ordinal categories such as extensive, substantial, moderate, limited & little if any.

Some of the composite measures are simple counts. Others such as this one are weighted, summed index of the respondents' answers to each of the questions. Much like a grade-point average, the answers are assigned ordered numeric values that are added and then divided by the number of valid answers to the series of questions for each respondent. For example extensive answers are scored as the value 5, substantial as 4, down to little if any as 1. Hence the values on the extremes of the weighted sum measures require consistency of replies across all of their respective component questions. The index scores are separated into categories based on the distribution of the total response values for ease of interpretation.

The weighting & summing are mathematically equivalent to an arithmetic mean; however, also much like a grade point average, the results are rank orders. Such indices are not interval- or ratio-level measures that can be added or multiplied meaningfully.

**See Appendix C in** CMU/SEI-2010-TR-022 (<a href="http://www.sei.cmu.edu/library/abstracts/reports/10tr022.cfm">http://www.sei.cmu.edu/library/abstracts/reports/10tr022.cfm</a>) for further detail.

# Relationship Between Healthy PPM Ingredients & Overall Value Attributed to PPMs: Emphasis



Still room for improvement in PPM emphasis

Which does seem to pay off

# Possible answers:

- Extensive
- Substantial
- Moderate
- Limited
- Little if any

#### **Interpreting the Mosaics & Gamma**

Most of the results described here summarize relationships between two variables. Many of them use a graphical mosaic such as this one to shows the extent to which the survey respondents' answers vary together in a consistent manner.

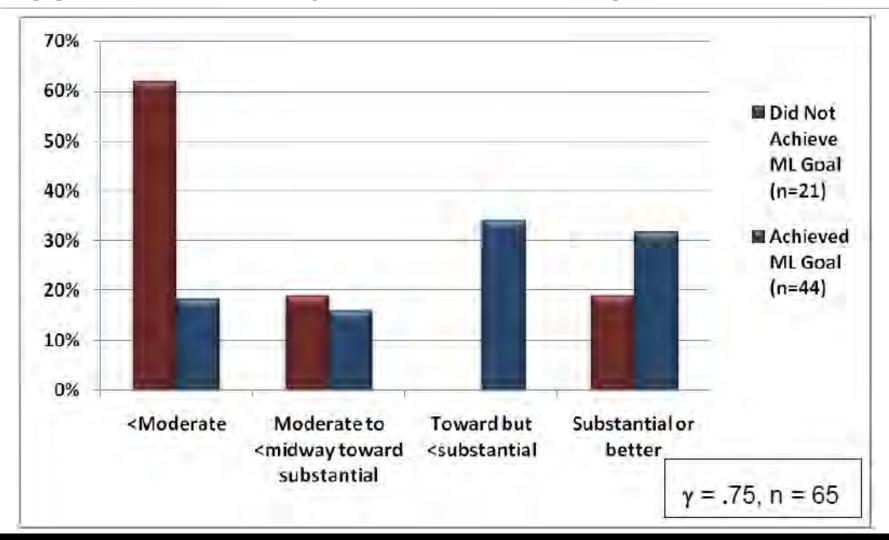
The values for each x-variable are displayed along the horizontal axis on the bottom of the mosaic, and labels for the respondents' answers to the y-factor are displayed to the right of the mosaic on the vertical axis. The proportions of responses for each category of the x-variable are shown in separate columns of the mosaic, where each value of the y-variable is represented in a separate mosaic tile. The width of each column varies in proportion to the number of responses for each category of the x-variable. This can provide a quick sense of how evenly or unevenly the survey answers are distributed.

The overall strength of the relationship between the two variables can be described by the value of the gamma statistic. Gamma is an ordinal measure of association that is appropriate for ordered categorical measures such as these. It is symmetric, which means that its value will be the same regardless of which variable is considered to be an x-variable or a y-variable.

The value of gamma is the proportion of paired comparisons where knowing the rank order of one variable reduces the proportionate error in predicting the rank order of the other variable. So, for example, if gamma is .75 then knowing the independent variable reduces our error in predicting the rank of the dependent variable by 75 percent.

See Appendix C in CMU/SEI-2010-TR-022 (<a href="http://www.sei.cmu.edu/library/abstracts/reports/10tr022.cfm">http://www.sei.cmu.edu/library/abstracts/reports/10tr022.cfm</a>) for further detail.

# Healthy PPM Ingredients & Achievement of Appraisal Maturity Level Goal: Emphasis

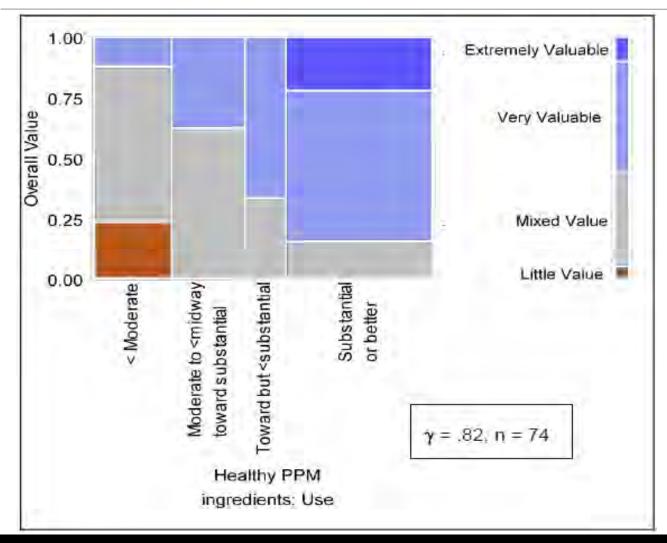


### **Healthy PPM Ingredients: Purpose**

To what degree are your organization's process performance models used for the following purposes?

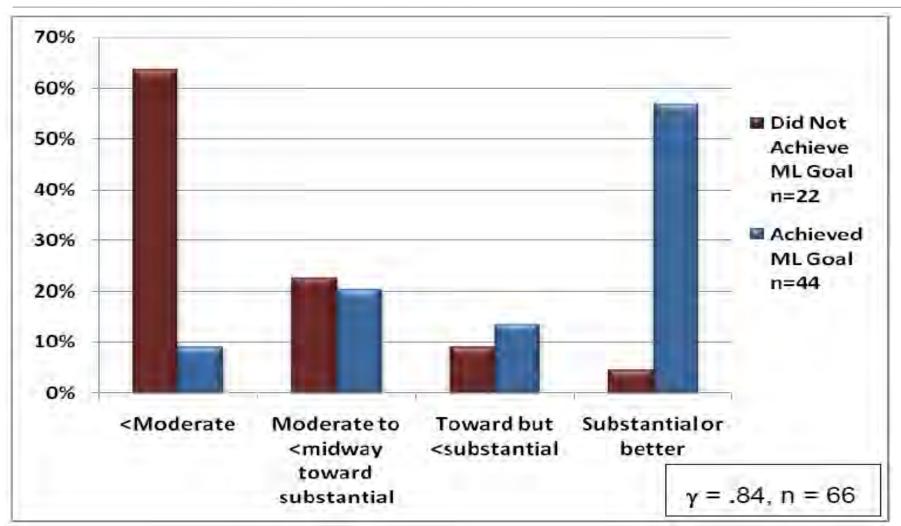
- Predict final project outcomes
- Predict interim outcomes during project execution (e.g., connecting "upstream" with "downstream" activities)
- Model the variation of factors and understand the predicted range or variation of the predicted outcomes
- Enable "what-if" analysis for project planning, dynamic re-planning and problem resolution during project execution
- Enable projects to achieve mid-course corrections to ensure project success

# Relationship Between Healthy PPM Ingredients & Overall Value Attributed to PPMs: Purpose



More do report using PPMs for the right reasons

# Healthy PPM Ingredients & Achievement of Appraisal Maturity Level Goal: Purpose

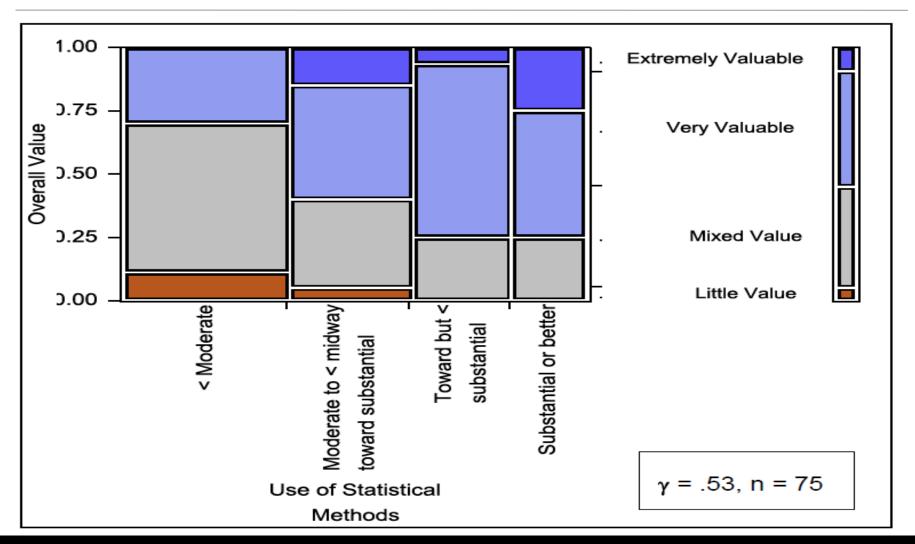


### **Statistical Analysis Methods**

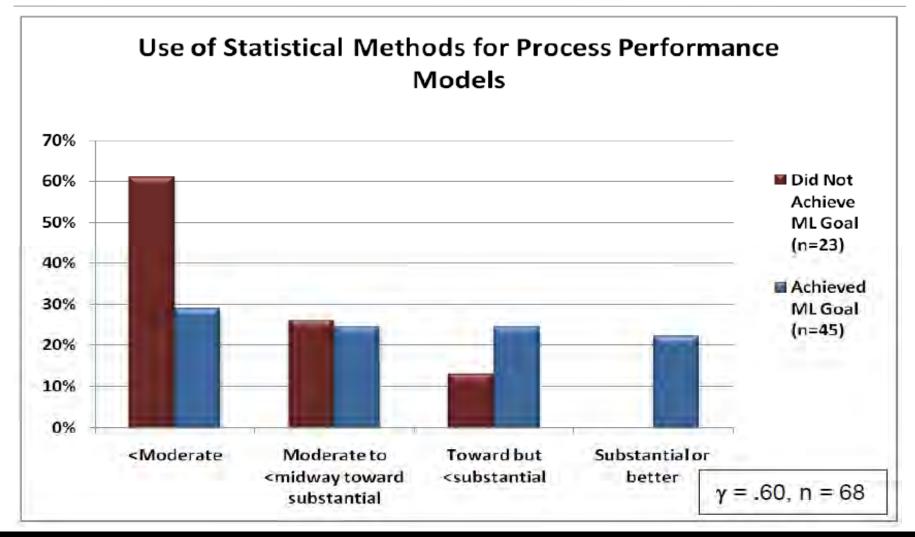
To what extent are the following <u>statistical methods</u> used in the organization's process performance modeling?

- Regression analysis predicting continuous outcomes (e.g., bivariate or multivariate linear regression or non-linear regression)
- Regression analysis predicting categorical outcomes (e.g., logistic regression or loglinear models)
- Analysis of variance (e.g., ANOVA, ANCOVA or MANOVA)
- Attribute SPC charts (e.g., c, u, p, or np)
- Individual point SPC charts (e.g., ImR or XmR)
- Continuous SPC charts (e.g., XbarR or XbarS)
- Design of experiments

# Relationship Between Use of Multiple Statistical Methods & Overall Value Attributed to PPMs



# Use of Multiple Statistical Methods & Achievement of Appraisal Maturity Level Goal

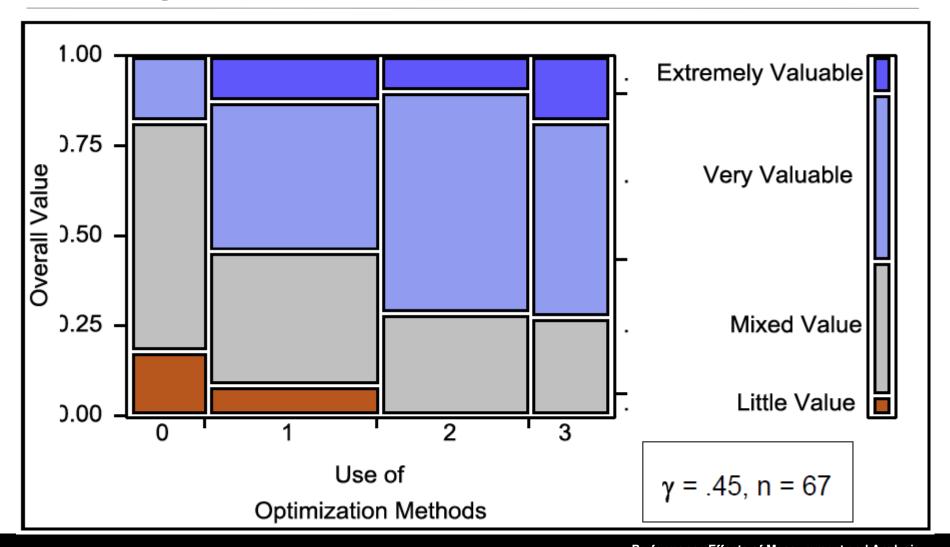


#### Simulation/ Optimization Techniques

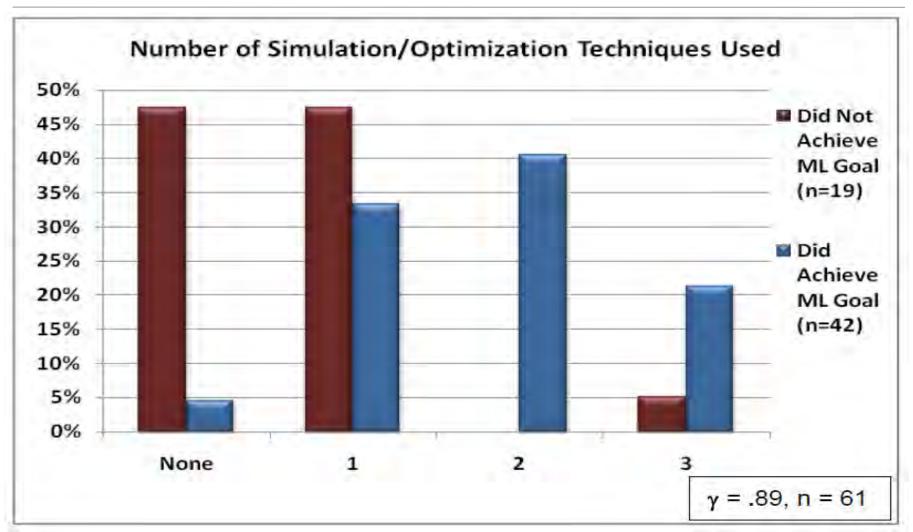
Which of the following other optimization approaches are used in your organization's process performance modeling?

- Monte Carlo simulation
- Discrete event simulation for process modeling
- Markov or Petri-net models
- Probabilistic modeling
- Neural networks
- Optimization

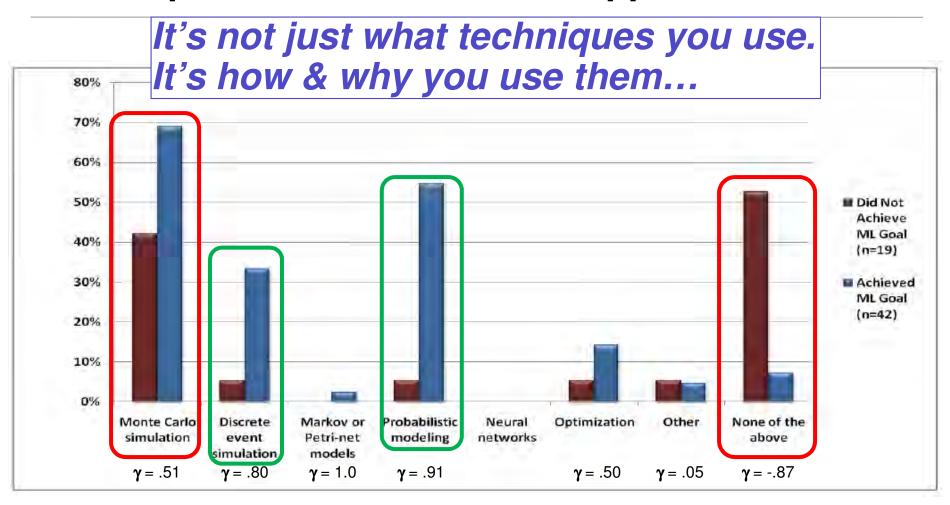
### Relationship between # of Simulation/Optimization Techniques used & overall value attributed to PPMs



# # of Simulation/Optimization Techniques Used & Achievement of Appraisal Maturity Level Goal



### Use of Specific Simulation/Optimization Techniques & Achievement of Appraisal ML Goal



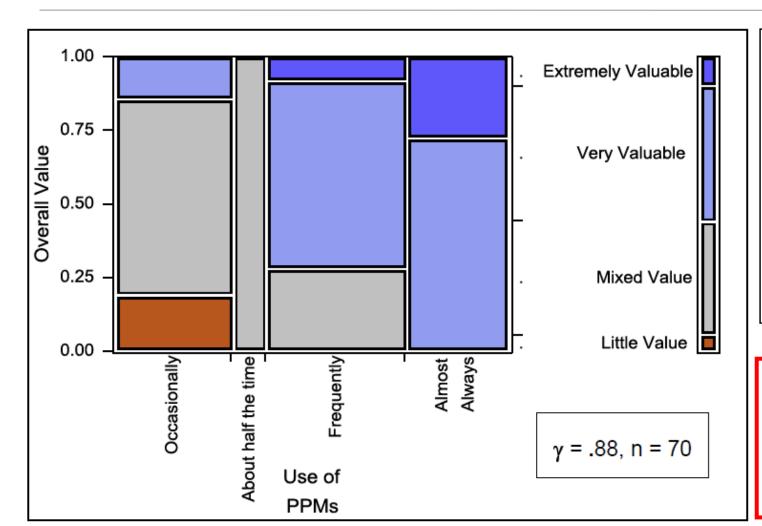
### It's the <u>uses</u> to which the results are put...

Measurement & analytical methods aren't all that's important for achieving high maturity status

Management processes are important too!

- With active participation of the intended users of the measurement results
- Who in turn are well equipped to understand the results

# Relationship Between Use of PPM Predictions in Reviews & Overall Value Attributed to PPMs

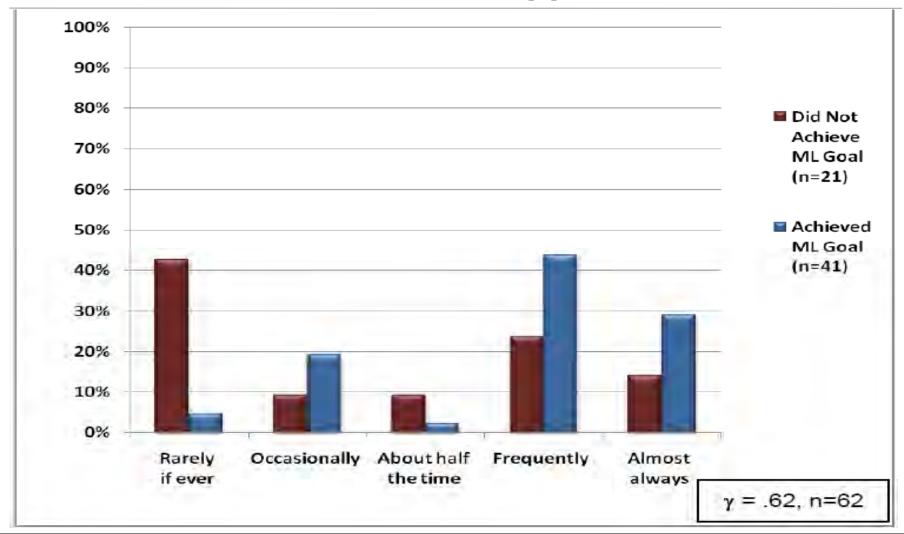


How often are process performance model predictions used to inform decision making in the organization's status and milestone reviews?

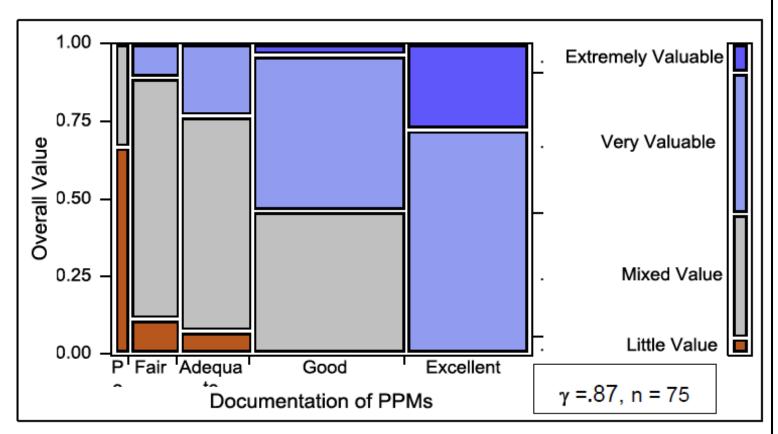
Of interest as a performance measure in its own right

Also for its impact on overall outcome

### Use of PPM Predictions in Status/Milestone **Reviews & Achievement of Appraisal ML Goal**

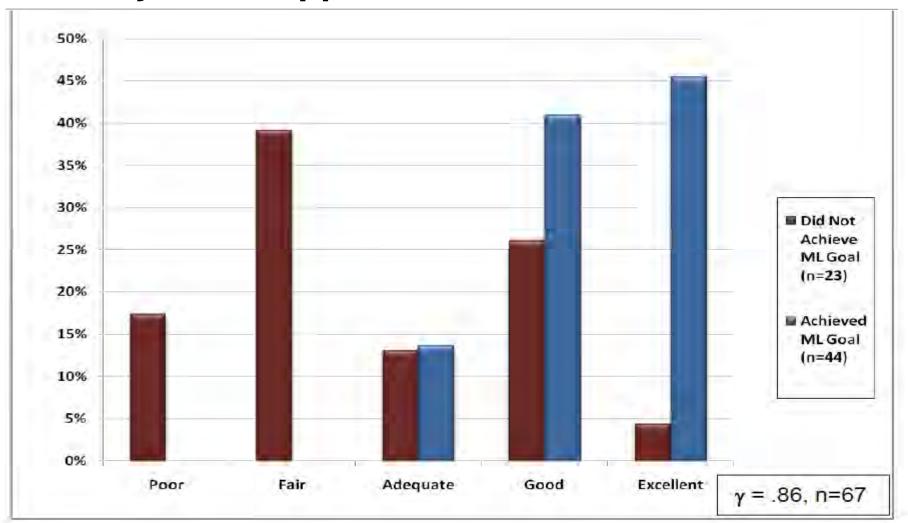


# Quality of PPM Documentation & Overall Value Attributed to PPMs

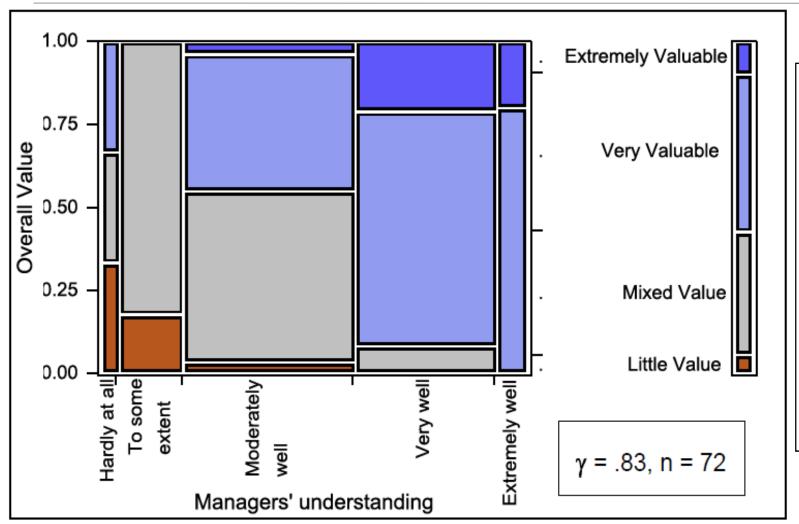


How would you best describe the organization's documentation of its process performance and quality measurement results (e.g., in the organization's PIIDs, measurement repository or process asset library)?

# Quality of PPM Documentation & Achievement of Maturity Level Appraisal Goal

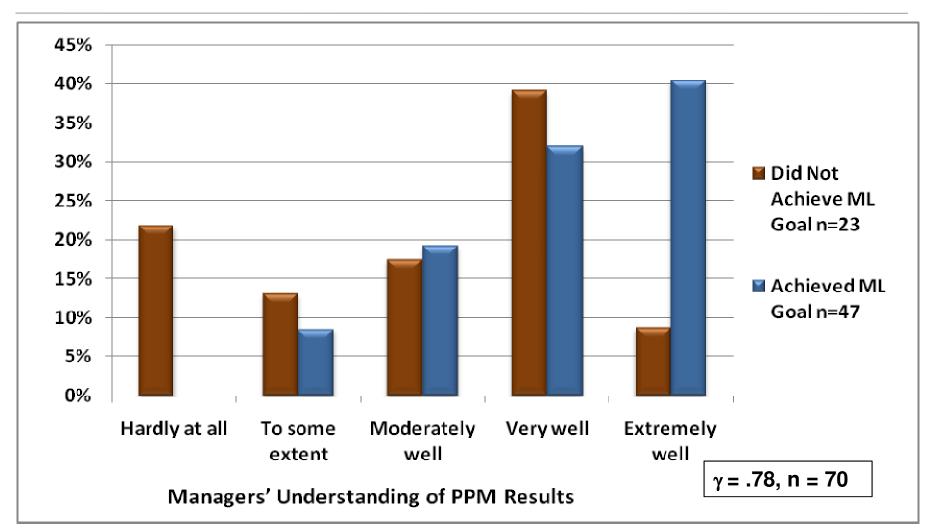


# Relationship Between Managers' Understanding of Model Results & Overall Value Attributed to PPMs



How well do
the
managers in
the
organization
who use
process
performance
model results
understand
the results
that they
use?

# Relationship Between Managers' Understanding of Model Results & Achievement of ML Goal



### Stakeholder Involvement

How would you characterize the involvement of various potential stakeholders in setting goals and deciding on plans of action for measurement and analysis in your organization?

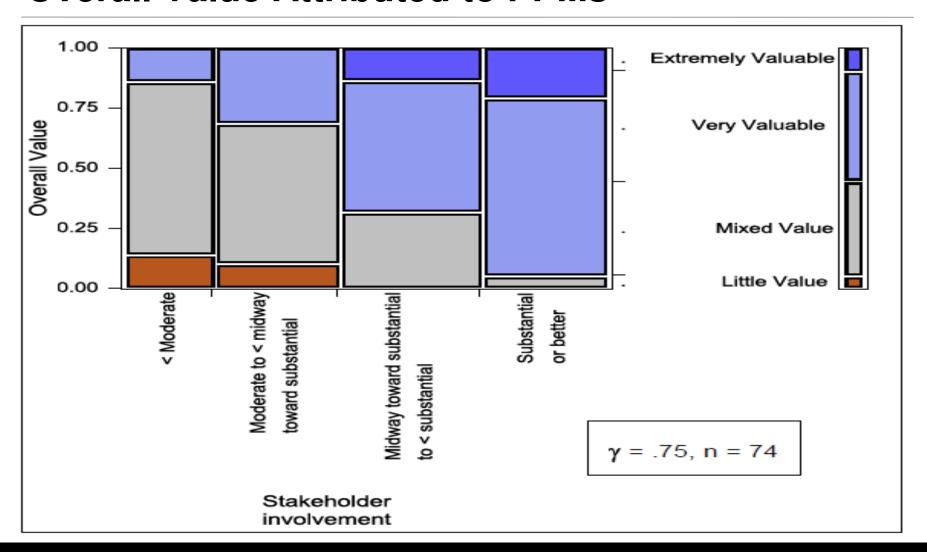
- Customers
- Executive and senior managers
- Middle managers (e.g., program or product line)
- Project managers
- Project engineers and other technical staff
- Process and quality engineers
- Measurement specialists

As per GQ(I)M

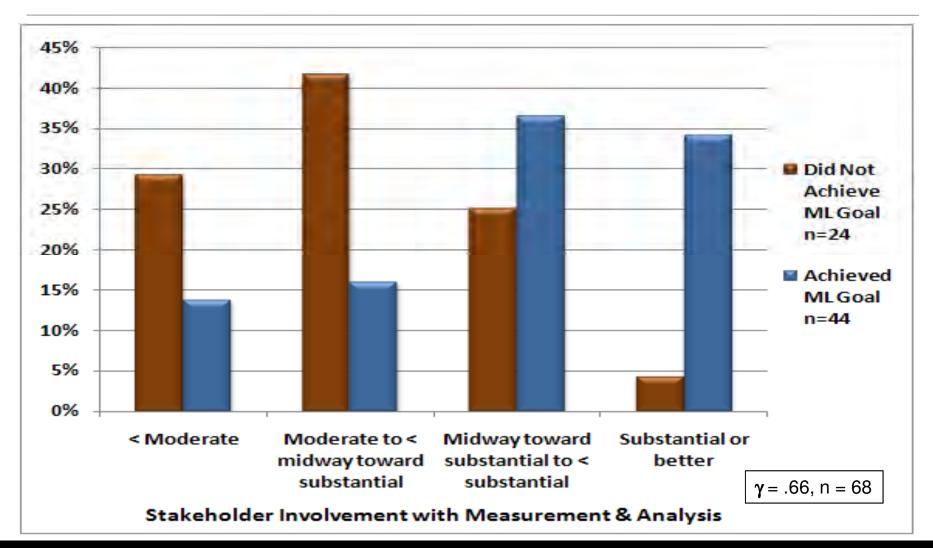
Measurement & **Analysis SG1, SP1** 

As well as GP 2.7

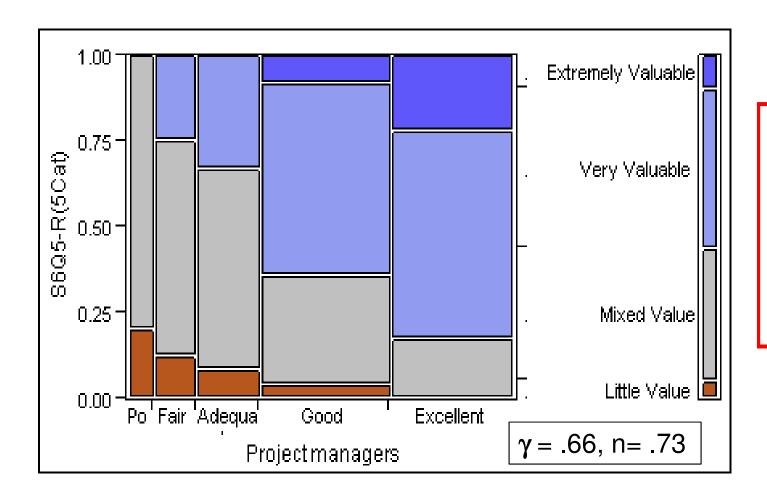
# Relationship Between Stakeholder Involvement & Overall Value Attributed to PPMs



# Relationship Between Stakeholder Involvement & Achievement of ML Goal

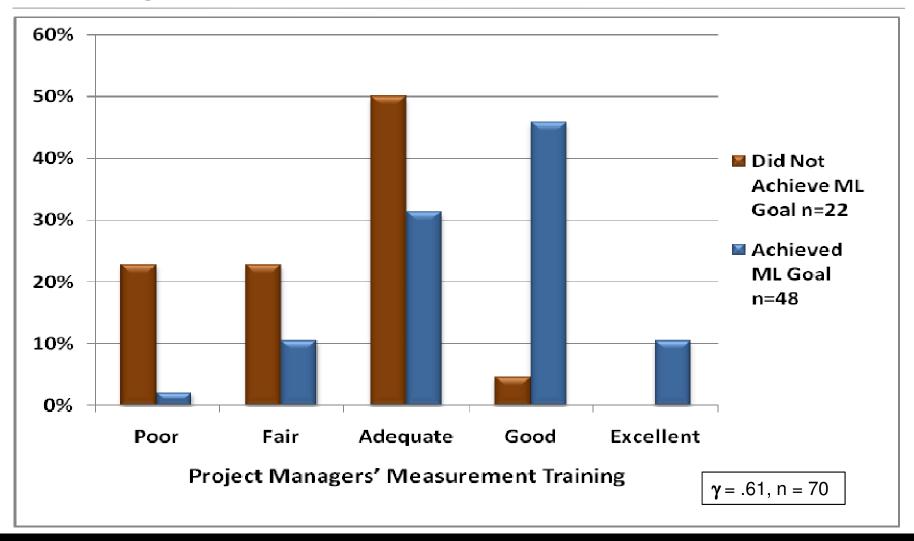


### Relation Between Quality of Project Manager Training & Overall Value Attributed to PPMs



How would you best characterize the measurement related training that is available (for project managers) in the organization?

### Relation Between Quality of Project Manager Training & Achievement of ML Goal



### Today's Talk

Scope of the presentation

More results from the 2009 high maturity survey in the SEI's series of measurement & analysis state-of-the-practice sample surveys

Summary, lessons learned & next steps

### Summary of Results<sub>1</sub>

Overall value of process performance modeling & related activities was judged to be more valuable for organizations that:

- Understood & used measurement & analysis activities more frequently
- Provided organizational resources & management support for the work

Organizations that achieved their appraised high maturity goals shared the same characteristics

 Moreover achievement of appraised high maturity status is closely associated with better project/program performance, product quality & organizational decision making

Replies to both surveys were generally consistent even though the two groups are often thought to be quite different

### **Summary of Results<sub>2</sub>**

HMLAs were slightly less positive overall in judgments of value added

But somewhat *more* positive than the sponsors about consistent use of process performance modeling approaches & analytical methods

Some conjectures about why that is so

- The HMLAs were reporting about more recent appraisals & coaching engagements
- The HMLAs were basing their judgments on evidence gathered at the project or program level
- The sponsors have a better understanding about overall goals & objectives
  - Which may not be addressed by the process performance modeling

### The Bottom Line Again...

Responses to 2009 survey of high maturity lead appraisers are consistent with the responses from representatives from appraised high maturity organizations surveyed in 2008

The community can be confident that the appraisers' judgments are consistent with the organizations' own views of the value of measurement & analysis to their work

### References

Dennis R. Goldenson, James McCurley, Robert W. Stoddard II, *Use and Organizational Effects of Measurement and Analysis in High Maturity Organizations: Results from the 2008 SEI State of Measurement and Analysis Practice Surveys*, CMU/SEI-2008-TR-024 (http://www.sei.cmu.edu/library/abstracts/reports/08tr024.cfm)

Dennis R. Goldenson, James McCurley, Robert W. Stoddard IICMMI, "Perspectives on Use and Organizational Impact of Measurement and Analytical Methods in CMMI High Maturity Organizations: Results from the SEI Annual Survey Series," CMMI Technology Conference & User Group, Denver, Colorado –19 November 009 (http://www.dtic.mil/ndia/2009CMMI/9244ThursdayTrack4Goldenson.pdf)

James McCurley, Dennis R. Goldenson, *Performance Effects of Measurement and Analysis: Perspectives from CMMI High Maturity Organizations and Appraisers*, CMU/SEI-2010-TR-022 (http://www.sei.cmu.edu/library/abstracts/reports/10tr022.cfm)

Robert W. Stoddard II, Dennis R. Goldenson, Dave Zubrow, Erin Harper, *CMMI High Maturity Measurement and Analysis Workshop Report: March 2008*, CMU/SEI-2008-TN-027 (<a href="http://www.sei.cmu.edu/library/abstracts/reports/08tn027.cfm">http://www.sei.cmu.edu/library/abstracts/reports/08tn027.cfm</a>)

Robert W. Stoddard II, Dennis R. Goldenson, *Approaches to Process Performance Modeling: A Summary from the SEI Series of Workshops on CMMI High Maturity Measurement and Analysis*, CMU/SEI-2009-TR-021 (http://www.sei.cmu.edu/library/abstracts/reports/09tr021.cfm)

Dennis R. Goldenson, Michael J. Zuccher, Robert W. Stoddard II, Whitepaper & updated web links on CMMI performance results, forthcoming TBD

### **Thank You for Your Attention!**

Jim McCurley & Dennis Goldenson

Software Engineering Institute Carnegie Mellon University Pittsburgh, PA 15213-3890 USA



**Carnegie Mellon** 

### **Back Ups**



# Why do the 2008 & 2009 High Maturity Samples Differ?

Surveyed high maturity lead appraisers (HMLAs) in 2009

Provides a useful comparison with those of the perspectives from the appraised organizations

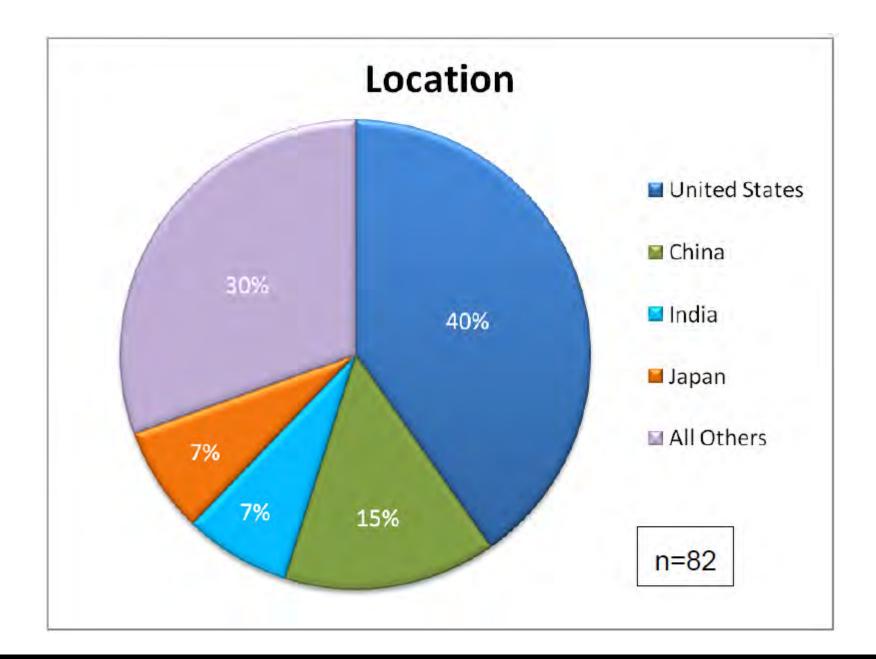
Intent has been to reuse & modify the 2008-2009 questionnaire in future years

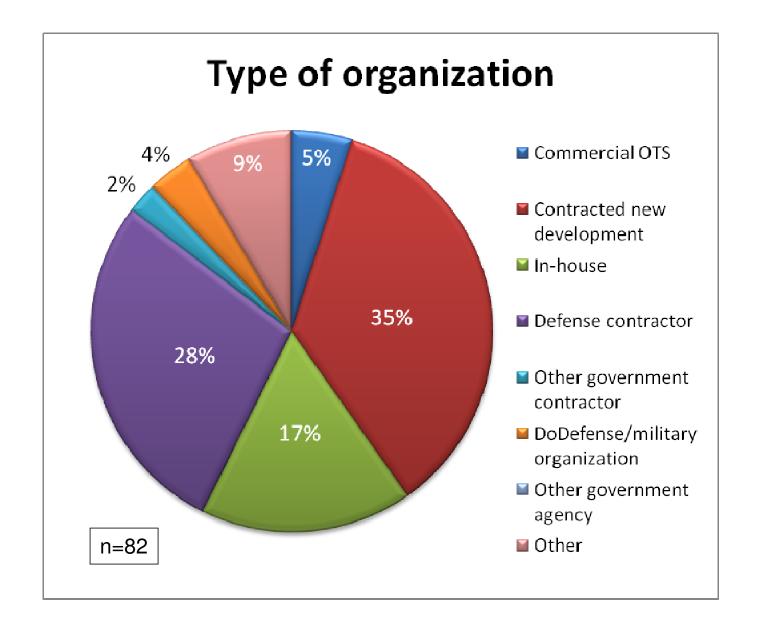
 Using the 2008 results as the baseline for tracking changes in high maturity organizations over time

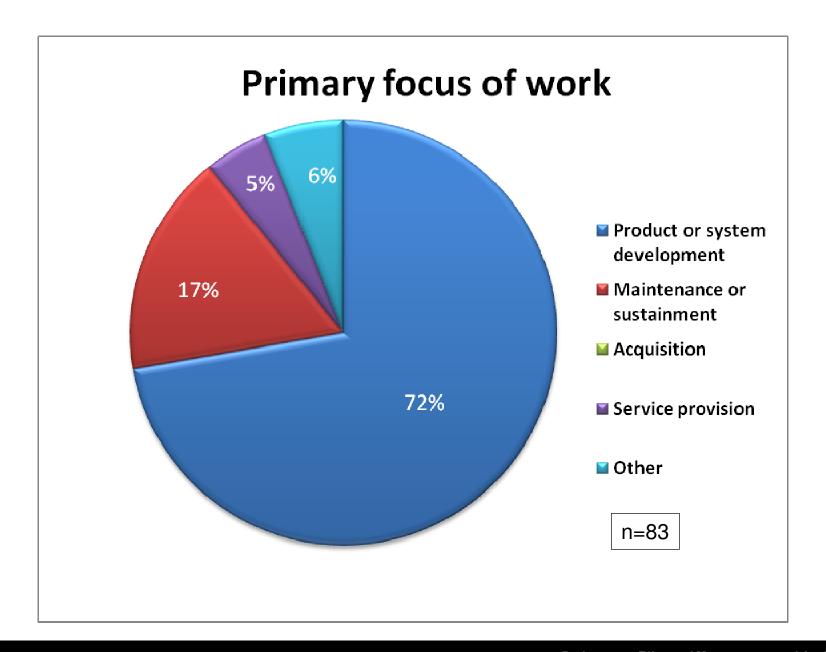
Only a limited number of organizations have achieved high maturity status

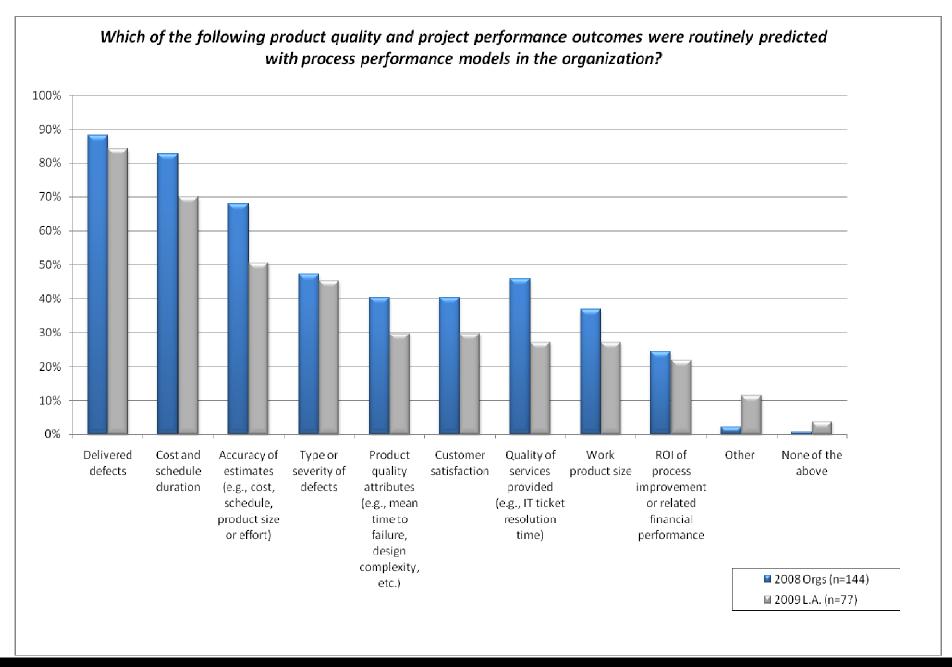
But we won't ask the same people to answer the same questions over & over each year

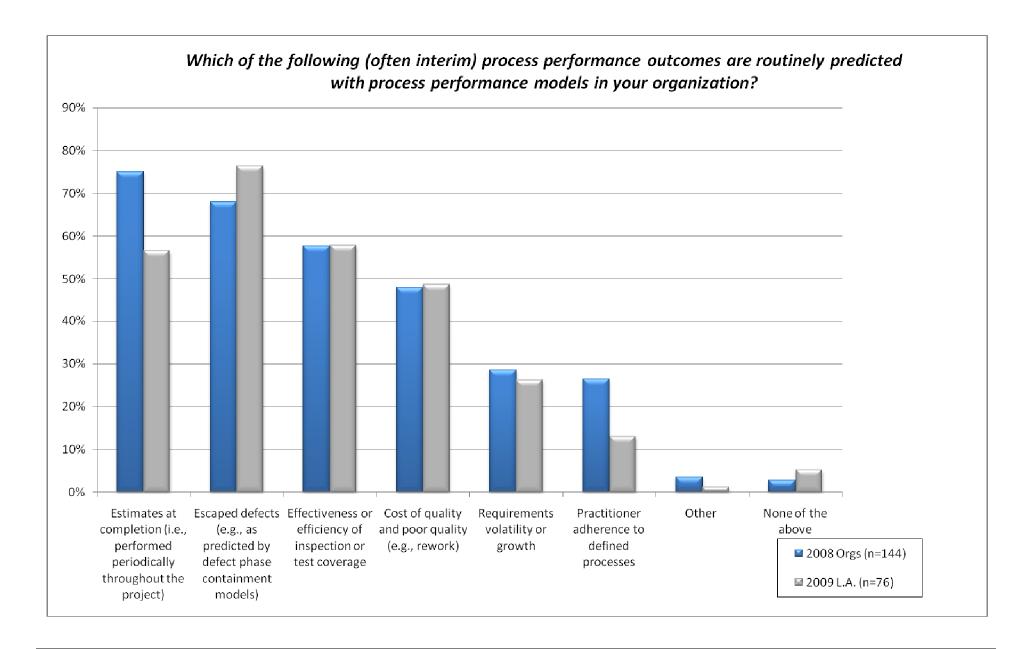
(Surveyed appraisal sponsors & their designees in 2008)

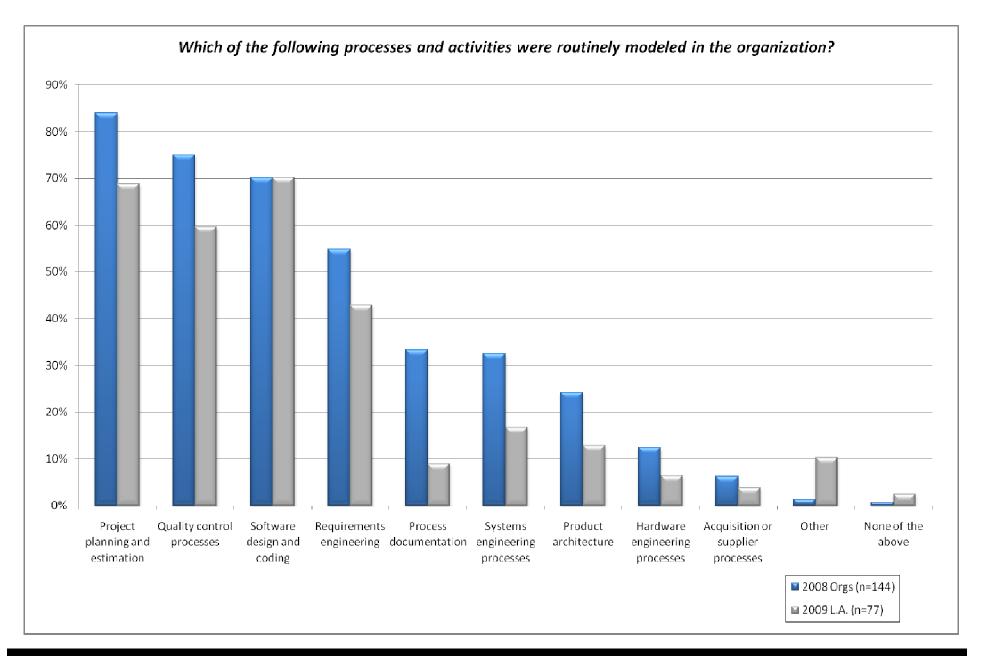












### Sampling Issues

Lower than desired response rates

Not surprising in relatively long questionnaires

### Exacerbated by:

- Repeated contact of the same individuals for business as well as survey purposes
- Demands on time from busy executives

Considering other sampling strategies for future surveys

"State of the practice" also can refer to very different target populations

- The SEI customer base ... the broader software & systems engineering community ... or those organizations that more routinely use measurement?
- Of course, the population depends on the purposes of the survey



### SYSTEMS MISSILES & SPACE GROUP

# System Engineering Process Improvement using the CMMI In Large Space Programs

Sarit Assaraf, Revital Goldberg

Israel Aerospace Industries



10th Annual CMMI Conference 15-19 Nov. 2010 Denver CO.

# Israel Aerospace Industries (IAI)





- Largest industrial company in Israel
- Missiles, Satellites, UAVs, Avionics, Upgrades, RADARS, etc.
- Activities encompassing: Development, Production, Maintenance and Service of Aerospace Systems
- ▲ IAI divisions are certified for ISO9000 and AS9100

S. ASSARAF . R. GOLDBERG – IAI Nov. 2010

# **IAI Organizational Chart**





Military A/C Group (3 Div.)

Commercial A/C Group (4 Div.) BEDEK Aviation Group (3 Div.)

Headquarters Organizations Engineering Group (2 Div.) Systems
Missiles
Space
Group
(5 Div.)

ELTA
Systems
Group
Ltd.
(4 Div.)

# Process Improvement – WHY?



# "The Quality of a System is Governed by the Quality of the Process Used to Develop it"

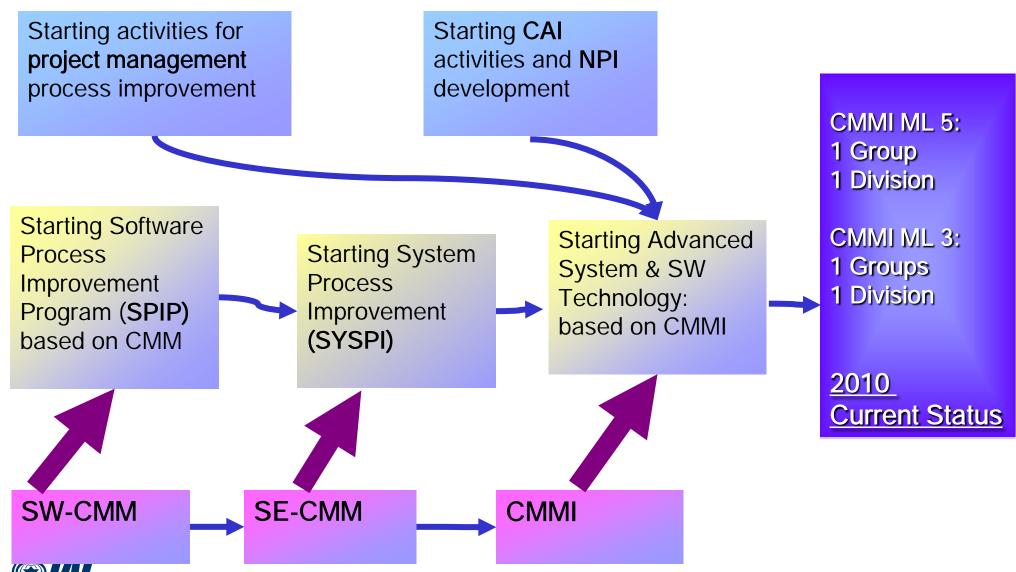
Watts Humphrey,

"Software Process Program" founder at the Carnegie Mellon's Software Engineering Institute



# IAI Process Improvement Path





YSTEMS MISSILES & SPACE GROUP

# **IAI Organizational Chart**





Military A/C Group (3 Div.)

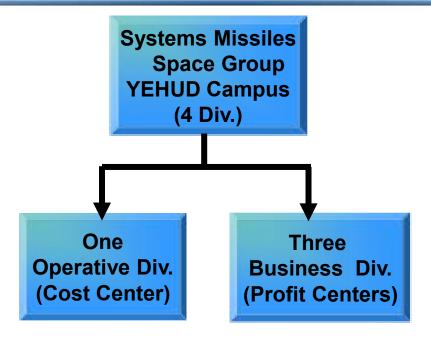
Commercial A/C Group (4 Div.) BEDEK Aviation Group (3 Div.)

Headquarters Organizations Engineering Group (2 Div.) Systems
Missiles
Space
Group
(5 Div.)

ELTA
Systems
Group
Ltd.
(4 Div.)

# CMMI & SEPG Program - Group Level (1)





- The CMMI implementation is managed as a program for process improvement at the group level
- SAPIR Standard Annual Process Improvement Roadmap
- The management concept is based on the CMMI ORG



### CMMI & SEPG Program - Group Level (2)

- Discipline based PITs Process Improvement Teams
   PM, SE, SW, HW, QA, CM, SAM, ORG
- PIT members = Process Leaders and Project
   Representatives
- Each PIT conducts meetings and activities, managed by PIT Leader
- ORG PIT comprises of all PITs Leaders
- CMMI Integrated plan consisting of all PITs' plans

### IAI Process Improvement Strategy



IAI Corporate Level

IAI VP Operations
Engineering & Development
CMMI Program Office

- Sponsorship
- Coordination
- Budget
- Process Assets Development

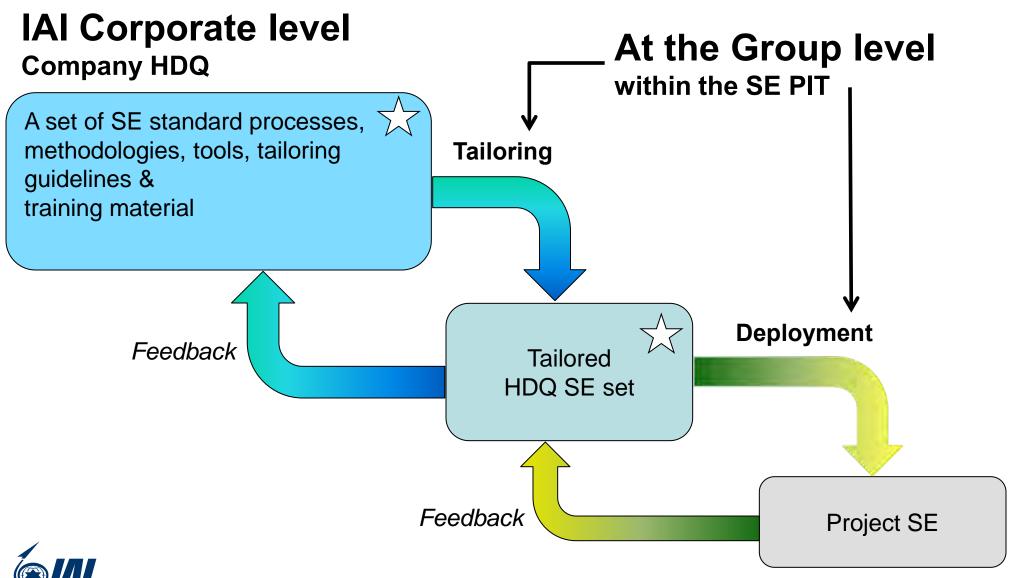
IAI Groups and Divisions

Process Improvement Activities

- Local Sponsorship
- Budget & Resources
- Process Assets Adaptation and Development
- Process Implementation
- Process Feedback

### **Process Definition and Tailoring Method**

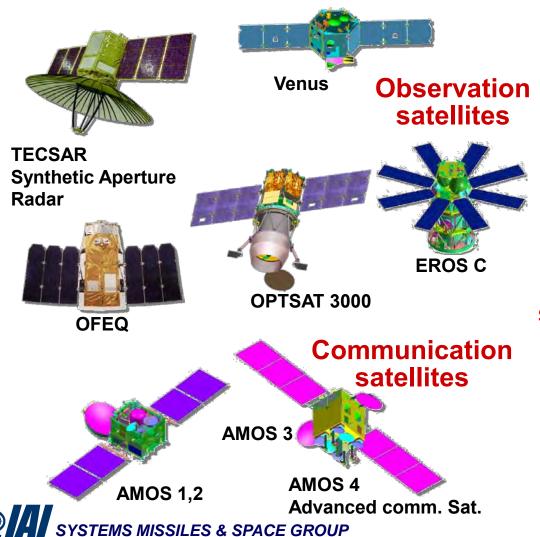




### **Space Systems**



### The Satellite Program = A System of Systems Program





Ground control stations



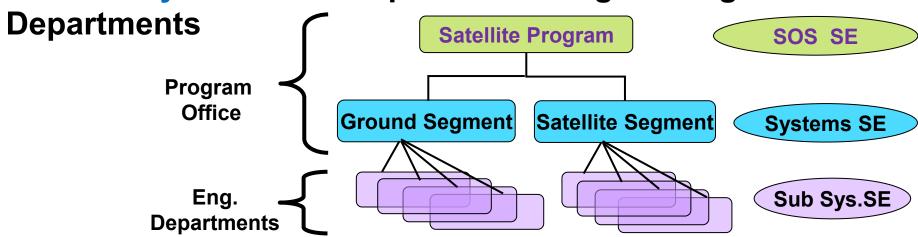
S. ASSARAF . R. GOLDBERG - IAI Nov. 2010

# IAI SPACE Programs Main Characteristics Program Internal Structure (1)



Decentralized SE at the group level –
 The SOS and the Systems SE are part of the program office, also managing the Sub-Contractors.

The Sub Systems SE are part of the Engineering

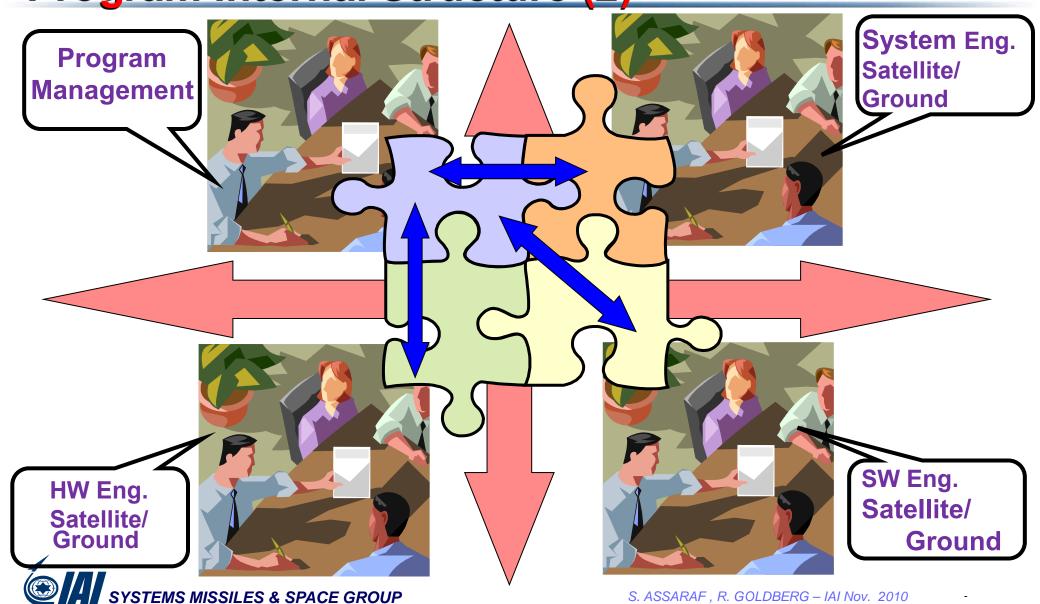


- Different views and meanings of SE activities adequate to each level of the system: SOS, System, Subsystem.
- Large project teams (often, geographically dispersed)



### IAI SPACE Programs Main Characteristics Program Internal Structure (2)





### IAI SPACE Programs Main Characteristics Program Internal Structure (3)



- FORMAL mutual commitment between the Program office and the Engineering Groups supports implementation of PP SP3.3, PMC SP1.2, REQM SP1.2 & IPM SP2.2:
  - The Program Office issues Internal Customer–Supplier Agreements
  - The Program Office allocates budget for the engineering groups against their commitment to supply adequate products on time
- The program establishes Integrated teams consisting of different disciplines (IPT = Integrated Product Teams)



### **IAI SPACE Programs Main Characteristics** Many Sub Contractors & Suppliers



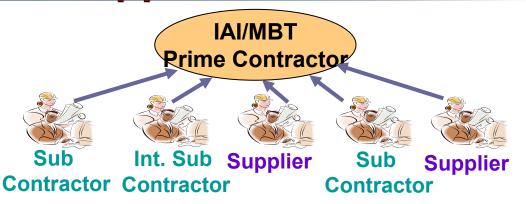
- Complex coordination
  - Internal (IAI) sub contractors
  - External sub contractors
  - Suppliers

Supports implementation of

IPM SP2.1, SP1.5; SAM SPs; TS SP2.4; DAR



- Scheduling
- Sub Contractors Monitoring
- Interfaces definition correctness and completeness (TS SP2.3, PI SP2.1)
- Integration Readiness Review (Pl SP3.1)



# IAI SPACE Programs Main Characteristics The Satellites "Nature"



 Each Satellite is "One of a Kind" however ...

- Verification & Validation are limited, especially by the ability to simulate the environmental conditions.

Support implementation of VER & VAL SP1.1, SP1.2, SP1.3

- Once Launched Repair activities are limited to SW corrections and updates.
   Requires special attention to:
  - Requirements validation at early development stages (RD SP3.5)
  - Analysis of Failures found on PI, VER & VAL stages (PI, VER SP3.2, VAL SP2.2)



### **Conclusions & Lessons Learned**



- The IAI process deployment method relies on a Corporate Level processes definition, followed by Group/Division Level tailoring and implementation.
- The products and projects characteristics require special attention to the RD, PI, VER & VAL process areas
- Using the internal Customer–Supplier
   Agreements and IPT's ensure
  - Better definition and management of the commitment
  - Integrated team work along the projects' life cycle



# Thank you

Sarit Assaraf - sassaraf@iai.co.il

Revital Goldberg - rgoldberg @iai.co.il





# How to Establish a Process Architecture and Use it for Process Improvement

CMMI Technology Conference & User Group 15-18 November 2010

Gary Palosaari, Ph.D. The Boeing Company

Gary.C.Palosaari@boeing.com 310-416-3591

### **Boeing Space and Intelligence Systems (S&IS)**

S&IS is Boeing's center for all intelligence and government / commercial space systems. It is the world's leading manufacturer of geostationary satellites, and has the largest dedicated satellite factory in the world. S&IS' headquarters is in Seal Beach, California.



CMMI® Core Team located in El Segundo, Southern California

### Agenda

- Process Management Challenges
- A well-designed Process Architecture overcomes the Challenges
- What makes up a Process Architecture?
- Steps to establish and maintain a Process Architecture
- Improving by using a Process Architecture
- Keys to success

### **Process Management Challenges**

- Too many processes
  - Redundant, contradictory
- Too many types
- Too many interfaces





No integrated views / roadmaps

### A well-designed Process Architecture Overcomes the challenges

#### Provides a bird's eye view

 Graphical representations establish a framework to help users find processes



# Provides insight into interrelationships and ordering

- Helps with process update impact analysis fewer unintended consequences
- Helps with planning, process deployment analysis

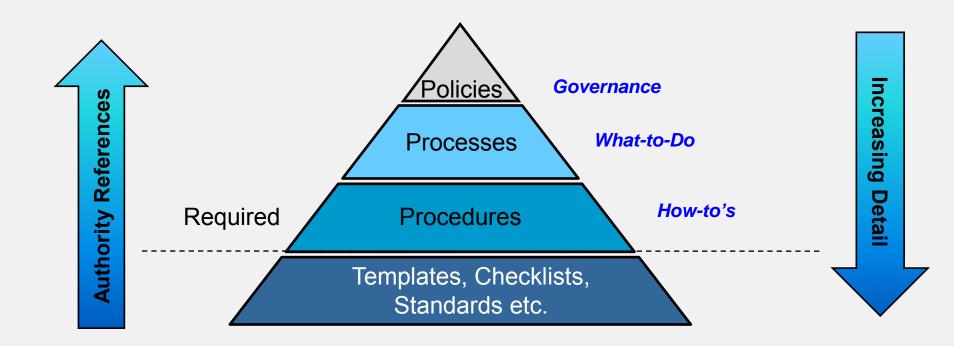


### What makes up a Process Architecture?

- Components (policies, processes, procedures, etc.) grouped in
  - Hierarchy
  - Contextual relationships
- Interfaces and interdependencies among the components
- Ordering of the components

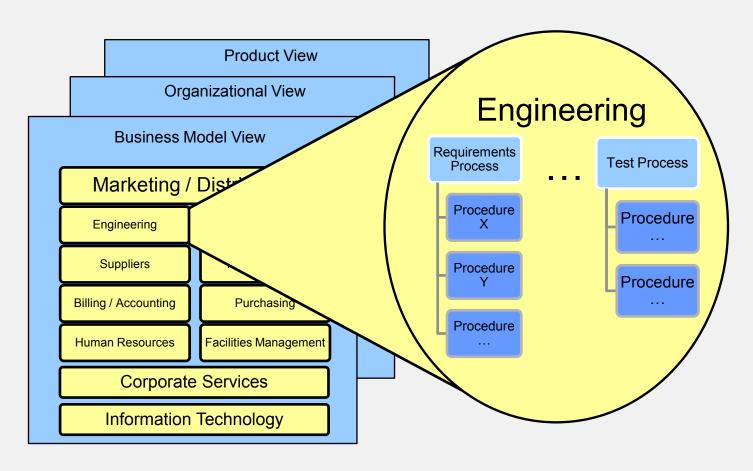
Note: For additional process architecture information see CMMI® (Ver. 1.2) – Glossary and Organizational Process Definition (OPD-SP 1.1)...

### Hierarchy



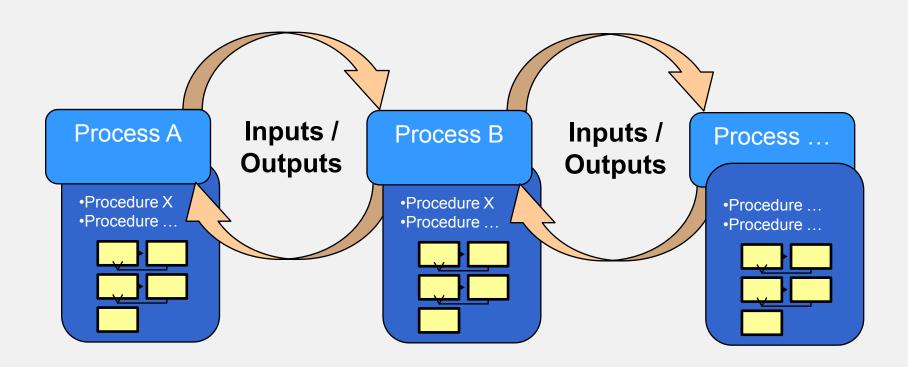
\*See [Olson 1994] for additional definition and relationship information

### **Contextual Relationships**



\*See [Olson 2008] for addition architecture examples

### Interfaces and Interdependencies

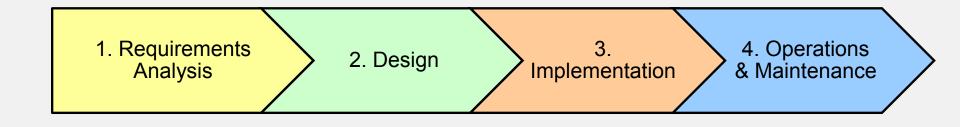


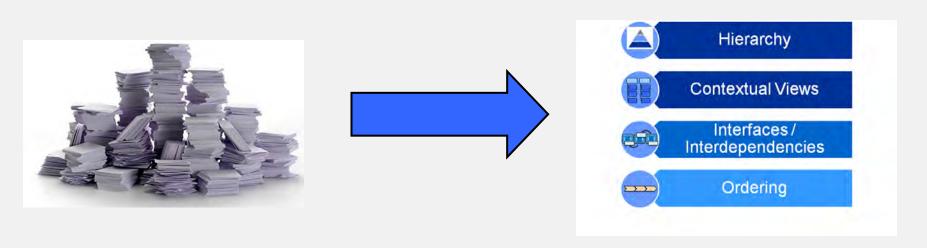
### **Ordering**

Order (sequencing, iteration, concurrency) is captured through process mappings to lifecycles, value streams, or process flows...

#### Lifecycle Example Phase 3 Phase 1 Phase ... Phase 2 Process A Process A Procedure X Procedure X Procedure Y Process B Procedure X Phase 2A Phase 1A Process A Process A Procedure Y Procedure Y

# Steps to Establish and Maintain a Process Architecture\*





\*See [Chang-Hyun, 2010] for additional information on how to build a software architecture

### 1. Requirements Analysis

#### • Identify and analyze process architecture requirements

- Use cases, scenarios (finding / improving processes)
- Existing documentation / interface standards
- CMMI®, AS9100 compliance
- Level of detail versus expert mode capability
- Weak versus strong associations between processes and procedures
- Process update impact analysis capability

#### Identify constraints

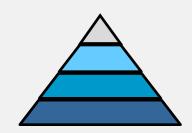
Legacy processes / architectures (potential multi-site issues)

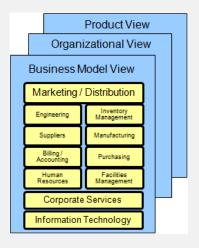
#### Identify and analyze quality attributes

- Simplicity / usability (processes should be easy to find)
- Flexibility and maintainability (architecture should be easy to update)
- Degree / levels of commonality (common processes can be to generic)
- Extensibility, reusability (allow for future expansion, building blocks)

### 2. Design

- Analyze structural alternatives and identify solutions
  - Identify layers of hierarchy and which components are required
  - Identify strength (level of detail) of process mappings
  - Establish process groupings and "look-and-feel" for contextual views
- Identify process and process element interfaces (e.g. I/O data, givers /receivers)
- Identify lifecycle phases to be process mapped
- Standardize process templates / definitions
- Evaluate tools / methods to build / populate the process architecture
  - Process Modeling Tools
  - Wiki's
  - Process Flow Diagrams





Note: See [Clements 2005] and [Clements 2010] for additional information on design principles and view selection criteria

### 3. Implementation

- Collect and catalogue components
  - Map procedures (How-to-Do's) to processes (What-to-Do's)



- Group processes and procedures into contextual views
- Product View

  Organizational View

  Burness Model View

  Marketing Object

  Covered

  Learner

  Le

Identify interfaces

Process A Outputs / Output

Map to lifecycles



### 4. Operations and Maintenance

- Establish change control mechanisms, tools, methods
- Monitor implementation / updates to ensure that architecture is maintained
- Integrate updates of your process architecture into your process management activities
- Re-factor as necessary, in response to process creep, acquisitions, or expanded functionality needs

# Improving Operations with a Process Architecture

- Navigation tool to find the right process at the right time
  - Views provide process context,
     "What-to-do" and "How-to-do" it
  - Lifecycle process mappings tell the user when to execute the "What-to-do's" and "How-to-do's"



# Improving Process Management with a Process Architecture

- Use interface information to identify potential impact of process updates
  - Follow I/O threads to eliminate unintended consequences
- Use contextual views to identify and eliminate areas of redundancy
- Identify high leverage areas (e.g. common tasks)
- Improve process deployment by identifying gaps / hidden
  - areas
- Improve alignment with Business Objectives
  - Maintain compliance to CMMI®, AS9100

### **Keys to Success**

- Understand the benefits of a well-designed Process Architecture
- Align your Process Architecture with your business needs and objectives
- Develop contextual views to
  - Find the right process at the right time
  - Efficiently improve processes
- Maintain your Process Architecture...Avoid the creep!!!



#### References

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- [Olson 2008] Olson, Timothy G. and Chris Armstrong. Architecture and Model Based Systems Engineering for Lean Results, Presentation, NDIA CMMI Technology Conference, 2008, Denver, CO.
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# Streamlined Approach to SW Estimating using COCOMO II

September 2010 Prepared by John M. Rossi Sr. Systems Engineer Rockwell Collins STS





#### **Agenda**

- Problem Description
- <u>Calibration Basics</u>
- Collector Forms
- Initial Results
- Summary
- <u>Lessons Learned</u>
- Recommendations
- Questions



#### Why The Need For A Standardized Estimating Tool?

- Need defendable Basis of Estimates for our pursuits
  - DCMA requirement
- Requirement for bids to be generated with a consistent and repeatable process
  - No way to accurately compare bids if different estimating tools and methods are used
- Estimation models must be calibrated to STS past program actuals before use on proposal activities
  - Use of standardized tool reduces effort required for calibration
- Level of knowledge on how to use the tools varies widely



#### What Estimating Tools Did STS Evaluate?

- COCOMO II 2000
- SEER-SEM
- TRUE-Planning (True-S)
- REVIC 9.2
- SLIM



#### COCOMO II 2000 Was Selected

#### Pros

- Latest revision of the COCOMO II model
- Extensive documentation to the model
- Model factors are changeable to the project
- Can be calibrated to STS Program Actuals
- Output uses standard Excel spreadsheets

#### Cons

- Need a training course on setting up and running the program
- Requires accurate Source Lines Of Code (SLOC) counts for each functional area to be estimated
- Many complex factors to learn which affect output
- Embeds non-engineering functions in effort estimates (Program Office, CM, QA, Manuals)



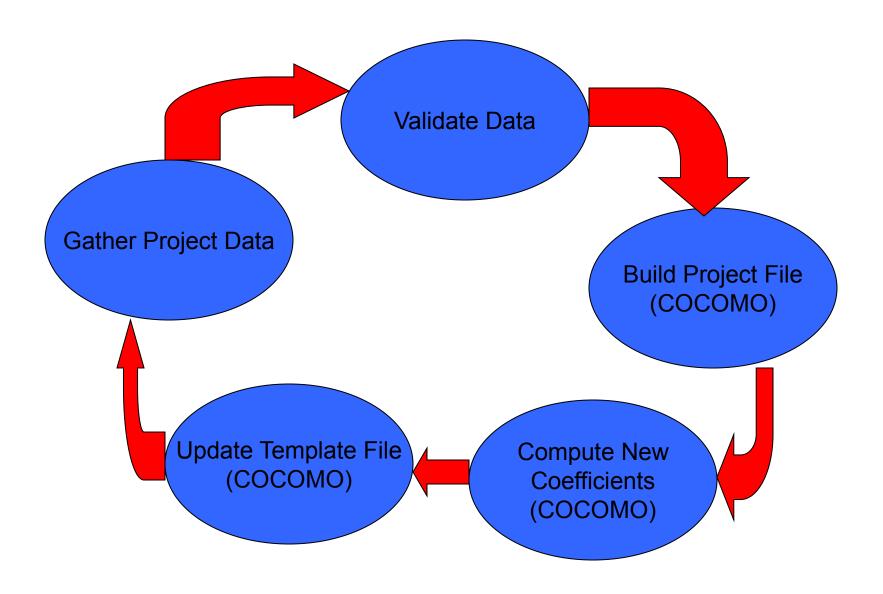
#### **Calibration Data Basics**

What did you do?
Adapt/Reuse SLOC
New Development SLOC

How long did it take (mo.), and how much effort (hrs.)

ACTUALS







#### **COCOMO Calibration Goals**

- By following the process...
- Calibrated values from COCOMO approach Program Actuals over many STS programs
- Calibrated COCOMO model becomes the standard Software
   Estimating tool for creating bids for proposals and ECPs for STS
- Using the Calibrated COCOMO Template establishes a defendable Basis of Estimate (BOE) for written narratives



#### We Selected COCOMO II, Now What?

- Need Data...And lots of it!!
- Need an easy, intuitive way to capture the SLOC from Programs
- Need to capture Program Actuals to build a calibration file with the SLOC



#### What Is SLOC?

- SLOC = "Source Lines Of Code"
- One SLOC is one logical line of code (an If-Then-Else is one line of code)
  - In COCOMO 81, known as Delivered Source Instructions (DSI). One If-Then-Else = X lines of code
- Only Source lines that are <u>DELIVERED</u> as part of the product are included -- test drivers and other support software is excluded
- SOURCE lines are created by the project staff -- <u>code created</u> by <u>applications generators is excluded</u>
- Declarations are counted as SLOC
- Comments <u>are not</u> counted as SLOC



### **Key Terminology**

- New Code: Completely new file development
  - Files developed from scratch for the program
  - Not ported from another program
- Reused Code: Code that is 100% reused (NO modifications)
  - Files taken from previous program baseline w/o change
  - Files taken from other programs w/o change
- Adapted Code: Existing code that will be modified (adapted) to work for the objectives of the program.
  - Existing files that will be modified for program objectives
  - Existing files that will delete code for program objectives
  - Existing files that will add code from other sources
  - Need the SLOC size <u>before</u> any modifications are made (baseline)



#### **Tools To Capture New/Adapted Code Count**

- <u>SLOCCount</u>: Standard STS tool for computing SLOC
- <u>Count LOC</u>: Alternate tool for computing SLOC
- Beyond Compare: Compare files for differences (New, Deleted, Modified lines of code)
- Perl Script: <u>Find Mods</u>
  - In-house tool to diff files or directories.
  - Outputs Metrics needed for collector



#### **Collector Forms**

- Rockwell Collins STS developed the SLOC Collector to capture data from programs
  - SLOC Collector
  - Project Info Collector
  - Engineers will complete form
- Both forms used to collect project SLOC Actuals and COCOMO factors for completed projects.
  - Forms are embedded into the Software Development Folders (SDF)



| 153                      |                   |                      | - Land Allaharian Indiana   |       |   |     |     |    |    |   |     |
|--------------------------|-------------------|----------------------|-----------------------------|-------|---|-----|-----|----|----|---|-----|
| 154                      | Surface Search    | Total Subsystem Size | B520SS/IUS/TGP              | 27180 | Č |     |     |    |    |   |     |
| 155                      |                   |                      |                             |       |   |     |     |    |    |   |     |
| 156                      |                   | Header File(s)       | TGP_Numeric_Entry_Page.h    |       | C | 57  |     |    |    |   |     |
| 157                      | New Coo           | do                   | TGP_Search_Page.h           |       | C | 81  |     |    |    |   |     |
| 158                      | Example           |                      | TGP_Search_Table_Page.h     |       | Č | 59  |     |    |    |   |     |
| 157<br>158<br>159<br>160 | column f          |                      | TGP_Search_Utilities_Page.h |       | Ç | 114 |     |    |    |   |     |
| 160                      | filled out        |                      | TGP_SPI_Loading_Page.h      |       | C |     | 132 | =1 | 10 | 4 | 0.6 |
|                          |                   |                      | AGWCP_Output.h              |       | C |     | 109 | 12 | 10 | 4 | 0,6 |
| 161<br>162<br>163        | Grayed            | out cells            | TGP_Shared.h                |       | Ċ |     | 118 | 5  | 10 | 4 | 0,6 |
| 163                      | SHOULI filled in. | <b>D NOT</b> be      |                             |       |   |     |     |    |    |   |     |



|          | A         | В                    | C                                       | U     | E        | r    | G       | Н  |        | L.  | K    | L    | M    |
|----------|-----------|----------------------|---|-------|----------|------|---------|--|--------|-----|------|------|------|
| 1        |           |                      |   |       | Primary  |      | Initial | Total  |        |     |      |      |      |
| 2        | Subsystem | File Type            | File Location/Name                      | Total | Language | New  | Adapted | Modified   | Reused |     |      |      | UNFM |
| 3        |           |                      |   | SLOC  |          | SLOC | SLOC    | SLOC   | SLOC   | (%) | (%)  | (%)  |      |
| 4        |           | Latina La            |   |       |          |      |         |  |        |     | ,443 | - 16 |      |
| 5        | IOS       | Total Subsystem Size | /smt/avio/                              | 27606 | C++      |      |         |  |        |     |      |      |      |
| 6        |           | Header File(s)       | /b52off_MalfActive.h                    |       | C+       |      | 25      | 1  |        |     | 30   | 0    | 0.2  |
| 7        |           |                      | l/b52off_malf_data.exx                  |       | C++      |      | 4147    | 600  |        |     | 30   | 0    | 0.2  |
| 8        |           |                      | .MVTXOffense.cxx                        |       | C++      |      | 1880    | 5  |        |     | 30   | ņ    | 0.2  |
| 9        | Need To   | otal                 | /b52off_malfs.h                         |       | C++      | ш    | 7200    | 760  |        |     | 30   | 0    | 0.2  |
| 10       |           |                      | #veaponCommonUtils.h                    |       | C++      |      | 403     | 50   |        |     | 20   | 2    | 0.2  |
| 11       | Subsys    | tem size             | /// // // // // // // // // // // // // |       | C++      |      | 114     | 10   |        |     | 20   | 2    | 0.2  |
| 12       | BEFOR     | F                    | /WeaponStatus.h                         |       | C++      |      | 82      | 1  |        |     | 20   | 0    | 0.2  |
| 13       |           |                      | /WpnConfig.h                            |       | C++      |      | 95      | 5  |        |     | 20   | 2    | 0.2  |
| 14       | modifica  | ations!              | /mgstargetdata.h                        |       | C++      |      | 166     | 12   |        |     | 30   | 2    |      |
| 15       |           |                      | /malfs.h                                |       | C++      |      | 850     | 39   |        |     | 30   | 2    | 0.2  |
| 16       | Adapted   | d Code               | /IOS_Shared.n                           |       | C++      |      | 684     | 4  |        |     | 30   | 0    | 0.2  |
| 17       |           |                      | /DicUtils.h                             |       | C++      |      | 496     | 1  |        |     | 30   | 0    | 0.2  |
| 18       | Exampl    | e. Fill in           | /weapon_defs.h                          |       | C++      |      | 191     | 1  |        |     | 30   | 0    | 0.2  |
| 19       | all non-  | grayed               | 1                                       |       |          |      |         |  |        |     | 1    |      |      |
| 20       | out cells |                      | /MalfActive.cpp                         |       | C++      |      | 694     | 19   |        |     | 30   | 2    | 0.2  |
| 21       | out cent  | 5.                   | /MapDisplay.cpp                         |       | C++      |      | 3603    | 71   |        |     | 30   | 8    | 0.2  |
| 22       |           |                      | /MgsLib.cpp                             |       | C++      |      | 677     | 4  |        |     | 30   | 6    | 0.2  |
| 23<br>24 | Graved    | out cells            | /mgsTargetData.cpp                      |       | C++      |      | 553     | 49   |        |     | 20   | 6    |      |
| 24       |           | D NOT                | WeaponCommonUtils.cpp                   |       | C++      |      | 1707    | 537  |        |     | 20   | 8    |      |
| 25       |           |                      | WeaponLoadlC.cpp                        |       | C++      |      | 898     | 180  |        |     | 30   | 8    | 0.2  |
| 26       | be filled | l in.                | MVeaponStatus.cpp                       |       | C++      |      | 381     | 7  |        |     | 30   | 4    | 0.2  |
| 27       |           |                      | MpnConfig.cpp                           |       | C++      |      | 702     | 6  |        |     | 30   | 4    |      |
| 28       |           |                      | ///weaponLoadOff.cpp                    |       | C++      |      | 936     | A CONTRACTOR OF THE PARTY OF TH |        |     | 30   | 2    | -    |
| 29       |           |                      | /Update_Wpn_IOS_data.c                  |       | C++      |      | 1122    | 2  |        |     | 30   | 2    | 0.2  |

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#### **Project Info Collector**

- Defines the Program Effort Adjustment Factors (EAFs)
  - Can be defined for whole project, OR tailored per subsystem
- Program Attributes are program wide
- Hover help available for all entries

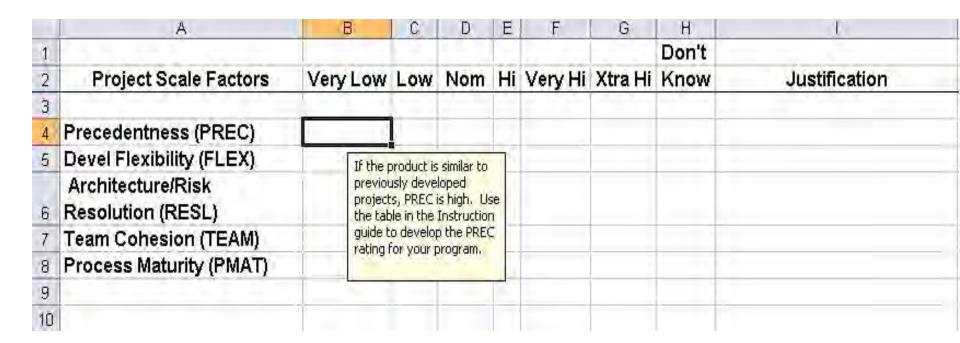


### **Project EAFs**

|    | A         | В                                       | С        | D   | E                          | F       | G       | Н       | 1     | J             |
|----|-----------|---|----------|-----|----------------------------|---------|---------|---------|-------|---------------|
| 1  |           |   |          |     |                            |         |         |         | Don't |               |
| 2  |           | Effort Multiplier Attributes            | Very Low | Low | Nom                        | Hi      | Very Hi | Xtra Hi | Know  | Justification |
| 3  |           |   | 1 1      | 3   |                            |         | 100     |         |       |               |
| 4  | Product   | Required SW Reliability (RELY)          |          | 1   | 1                          |         |         |         |       |               |
| 5  |           | Database Size (DATA)                    |          | T   | he effect of               |         |         |         |       |               |
| 6  |           | Documentation (DOCU)                    |          |     | oftware fail               | ures is |         |         |       |               |
| 7  |           | Product Complexity (CPLX)               |          |     | iw, easily<br>ecoverable l | osses.  | 6       |         |       |               |
| 8  |           | Develop for Reuse (RUSE)                |          |     |                            |         |         |         |       |               |
| 9  |           |   |          |     |                            |         |         |         |       |               |
| 10 | Platform  | Execution Time Constraint (TIME)        |          |     |                            |         |         |         |       |               |
| 11 |           | Main Storage Constraint (STOR)          |          |     |                            |         |         |         |       |               |
| 12 |           | Platform Volatility (PVOL)              |          |     |                            |         |         |         |       |               |
| 13 |           |   |          |     |                            |         |         |         |       |               |
| 14 | Personnel | Analyst Capability (ACAP)               |          |     |                            |         |         |         |       |               |
| 15 | 1         | Programmer Capability (PCAP)            |          |     |                            |         |         |         |       |               |
| 16 |           | Personnel Continuity (PCON)             |          |     |                            |         |         |         |       |               |
| 17 |           | Applications Experience (APEX)          |          |     |                            |         |         |         |       |               |
| 18 |           | Platform Experience (PLEX)              |          |     |                            |         |         |         |       |               |
| 19 |           | Language/Tool Experience (LTEX)         |          |     |                            |         |         |         |       |               |
| 20 |           |   |          |     |                            |         |         |         |       |               |
| 21 | Project   | Use of SW Tools (TOOL)                  |          |     |                            |         |         |         |       |               |
| 22 |           | Multi-site Development (SITE)           |          |     |                            |         |         |         |       |               |
| 23 |           |   |          |     |                            |         |         |         |       |               |
| 24 |           | Required Development<br>Schedule (SCED) |          |     |                            |         |         |         |       |               |



#### **Project Attributes**

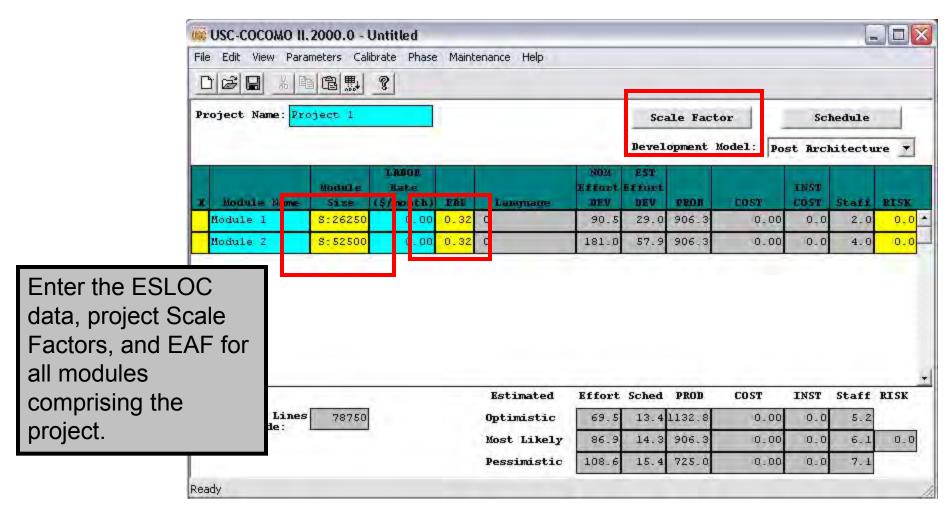




#### **Creating Calibration File**

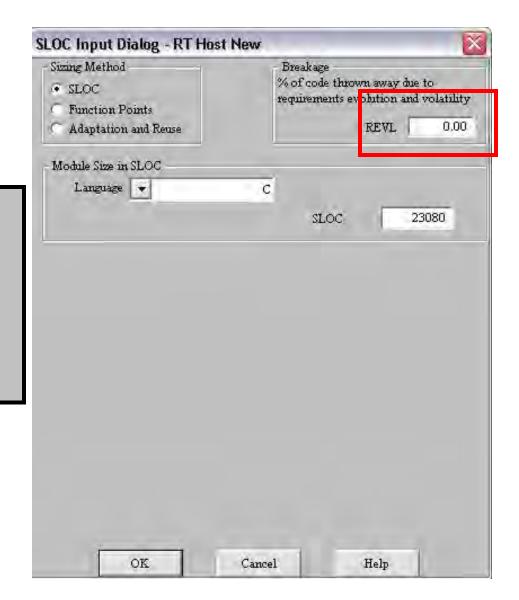
- COCOMO II has a built in Calibration method
- A calibration file can be created by entering actual data (SLOC and Effort) for each project
- The project can be characterized by any number of modules representing the subsystems
- The data entered should reflect the actual SLOC produced (New, Adapted, Reused), the EAF's associated with those subsystems, and the Scale Factors for the Project as a whole







Enter all data for each subsystem as Equivalent SLOC (ESLOC), as calculated from the collector form. (REVL=0 for completed projects)





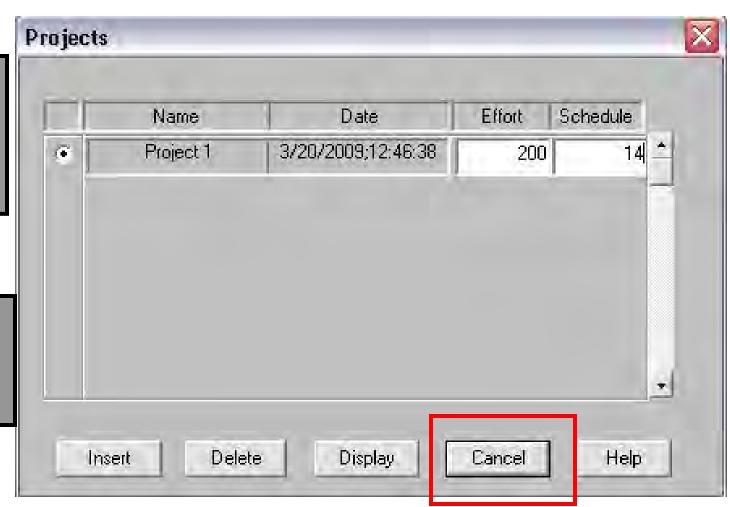
#### **Project Effort Actuals**

- Once a project has been defined, the effort and schedule actuals for that project need to be entered
- This is done by selecting the Project selection from the Calibrate pull-down
- The inputs are Effort and Schedule
  - Effort is defined in Person-Months (PM)
  - Schedule is input in Months duration



Enter the actual Project Effort in Person-Months, and Schedule in Months.

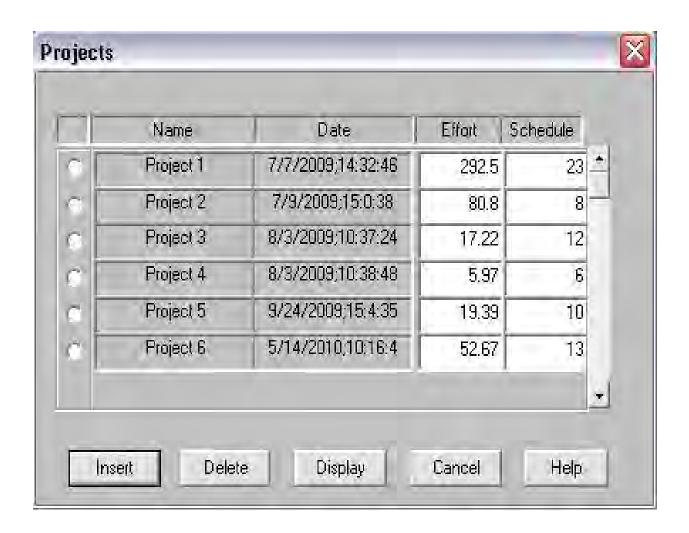
When completed with Project 1, select the Cancel button.



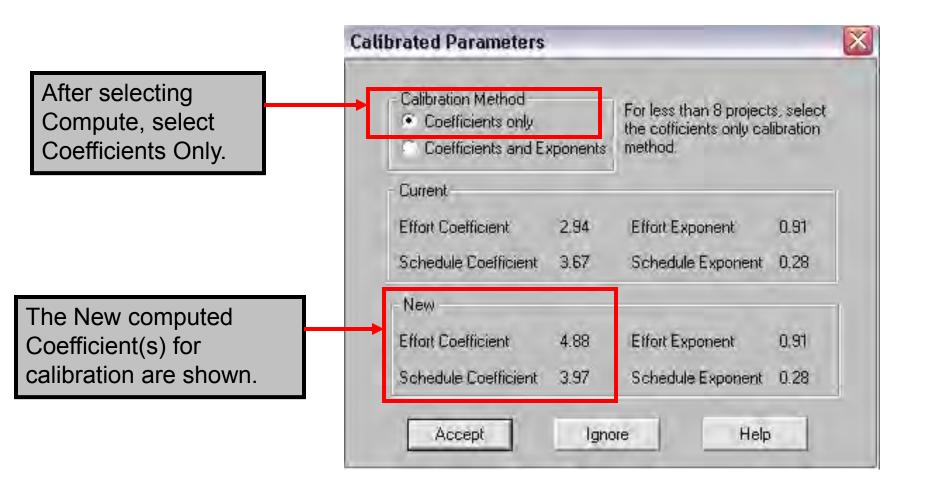


Repeat those same steps for each project.

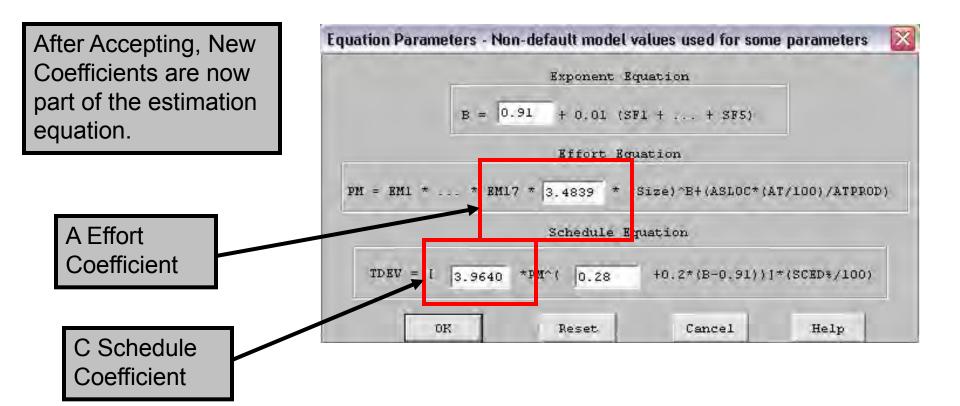
End result will be a calibration file composed of many STS projects. This will produce more accurate effort estimates based on STS actuals.













#### **Calibration Results**

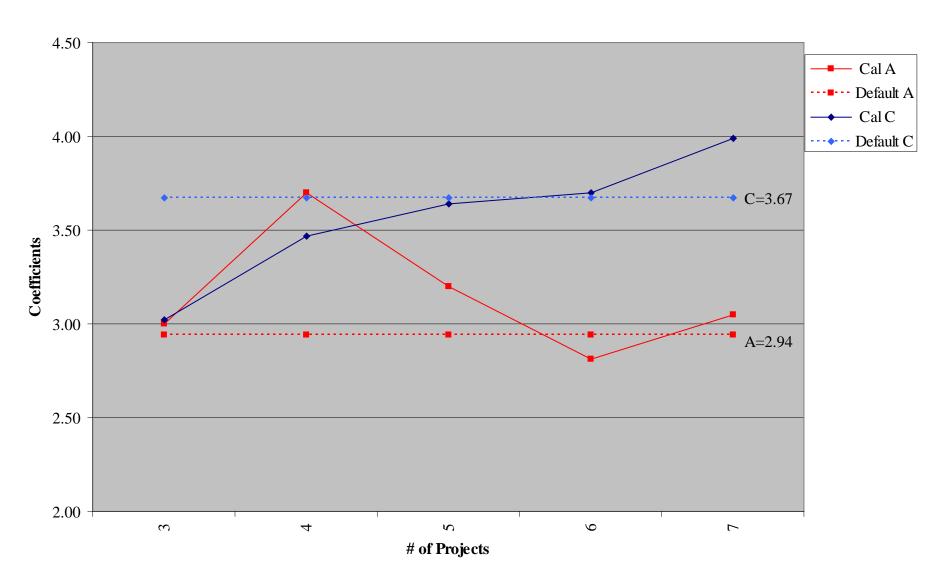
 Now we have several projects for calibration, what does that tell us?



|    | A | В         | C      | D        | E           | F           | G           | H          | 1           | J          | K          |  |
|----|---|-----------|--------|----------|-------------|-------------|-------------|------------|-------------|------------|------------|--|
| 1  |   | -         | Actual | Cocomo   | Cocomo 2000 | Cocomo 2000 | Cocomo 2000 | Calibrated | Calibrated  | Calibrated | Calibrated |  |
| 2  |   | Project   | PM     | 2000     | Plans + Req | Variance    | Variance    | Cocomo     | Plans + Req | Variance   | Variance   |  |
| 3  |   |           |        | PM       | PM          | PM          | (%)         | PM         | PM          | PM         | %          |  |
| 4  |   |           |        |          |             |             |             |            |             |            |            |  |
| 5  | 1 | Project 1 | 292.50 | 295.153  | 315.814     | 23,31       | 7.97%       | 282.091    | 301.837     | 9.34       | 3.19%      |  |
| 6  | 2 | Project 2 | 80.80  | 80.895   | 86.558      | 5.76        | 7.13%       | 77.315     | 82.727      | 1.93       | 2.38%      |  |
| 7  | 3 | Project 3 | 5.97   | 5.549    | 5.937       | -0.03       | -0.55%      | 5.304      | 5.675       | -0.29      | -4.94%     |  |
| 8  | 4 | Project 4 | 17.22  | 7.273    | 7.782       | -9.44       | -54.81%     | 6.951      | 7.438       | -9.78      | -56.81%    |  |
| 9  | 5 | Project 5 | 19.39  | 31.888   | 34,120      | 14.73       | 75.97%      | 30.477     | 32.610      | 13.22      | 68.18%     |  |
| 10 | 6 | Project 6 | 52.67  | 105.944  | 113.360     | 60.69       | 115.23%     | 101.255    | 108.343     | 55.67      | 105.70%    |  |
| 11 | 7 | Project 7 | 4      |          |             |             |             |            |             |            |            |  |
| 12 | 8 |           |        |          |             |             | 1           |            |             |            |            |  |
| 13 |   | Average   |        |          |             | 18.99       | 43.61%      |            |             | 15.04      | 40.20%     |  |
| 14 |   |           |        |          |             |             |             |            |             |            |            |  |
| 15 |   |           | Note:  | PM = 152 | Hrs.        |             |             |            |             |            |            |  |
| 16 |   |           | 10000  |          | (3.5)       |             |             |            |             |            |            |  |
| 17 |   |           |        |          |             |             |             |            |             |            |            |  |



#### **Calibration Coefficients**





#### **Variance Explanations**

- Data Collection on 1<sup>st</sup> two programs done imprecisely
- Initial collector forms not as rigorous, or intuitive as current forms (Updated and more user friendly)
- More knowledge garnered from USC on COCOMO factors and definitions (flowed into Collectors)
  - 1st several projects lacked knowledge
- Project 4 mainly a HW project (SW only effort extracted)
- Only 6 projects (Really need >8 quality data projects)
  - Several more projects currently in work



#### **STS COCOMO Templates**

- 2 Templates are available:
- STS COCOMO Template Calibrated
  - STS Calibrated coefficients are part of this file
  - Effort Factors tailored to typical STS project
  - Examples of types of code estimates shown
- STS COCOMO Template Uncalibrated
  - Only Effort Factors tailored to typical STS project
  - Uses out-of-the-box calibration coefficients
  - Examples of types of code estimates shown



#### **Summary**

- STS SW Estimating getting better
  - More programs needed for calibration
  - End Users more knowledgeable in completing forms
- Collector Forms still evolving
  - Still fairly complex even with additional work
  - Becoming easier to populate
- Data flowed into database to auto-generate COCOMO project file
  - Generate estimates faster



#### **Lessons Learned**

- COCOMO model and factors very complex
  - Definitions of factors hard to understand
  - End user knowledge varies across programs
- Engineers/PMs perceive non-value added work
  - Collecting SLOC still an uphill battle with Projects
    - Automation only minimally helps
    - "What's the charge #?"
  - See no immediate benefit to them
- WBS structure not aligned with model to accurately capture actuals
  - Added analysis time to align w/model
  - May lead to errors in effort
- Collectors help, but are not perfect.
  - Collectors improved with feedback from end users
  - Data collection more thorough now



#### Recommendations

- Standardized Tool Needed
  - Pick one and stick to it.
  - Become educated on complexity of tool
- Single focal point for collecting SLOC and Actuals
  - Keep out of engineers hands
  - Speeds process of creating calibration projects
- Get Buy-in from all functional areas on benefits
  - Why does it benefit the corporation? -> More accurate estimates.
- Capture costs in way that aligns with SW Estimating model
  - Align WBS with model to accurately capture actuals





## NDIA 10<sup>th</sup> Annual CMMI Technology Conference

# "How MBE can support Requirements Development and Technical Solution."

**November 18, 2010** 

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## **Outline**

#### HPT

- Current State of Practice
- Improving the State of Practice
- Vision, Definitions
- How MBSE can support RD and TS
- Planning Consideration
- Conclusion

## **Current State of Practice**

#### HPT

- Requirements are captured in database applications
  - They are often not accurate or complete
  - They take a long time to develop
  - They are published and viewed as documents
  - > It is difficult to achieve IPT consensus
- Technical Solution is captured in various forms
  - CAD/CAE, PowerPoint Slides, Simulations, and assembled in paper based documents.
- Often traceability is weak and hard to maintain.
- Our current engineering practices lack the rigor and discipline necessary to be explicit

## Is There a Better Way?

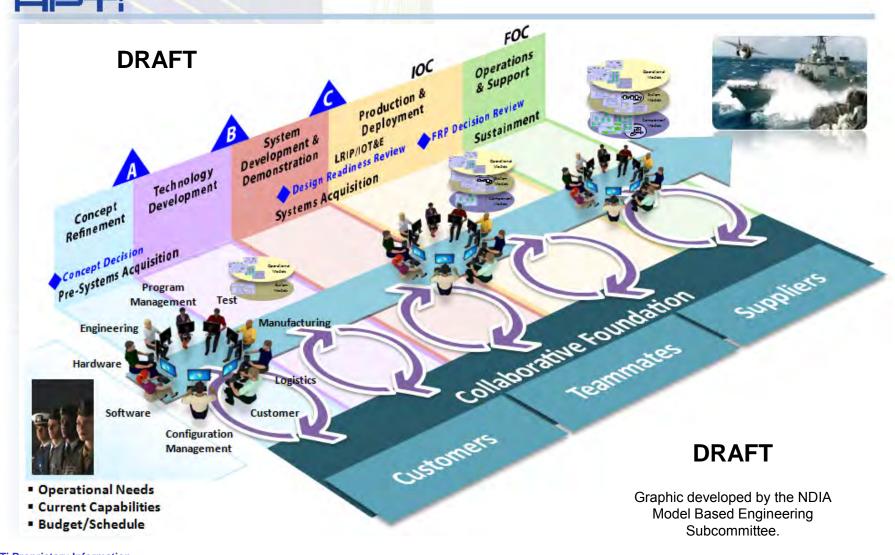


- What if the Requirements and Technical Solutions were all captured in one location and everything was traceable?
- What if we could validate our requirements at the same time we are developing our technical solution?
- What if the IPT could reach agreement to what the requirements are and what they mean.
- Can a Model Based Engineering Approach Help?

"You cannot engineer something if you cannot see it."

Scott Workinger

# Vision for Model Based Engineering (MBE)



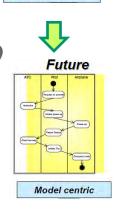
## **MBSE - General Definition**

#### HPT:

- It is about System Modeling
  - System Model is a <u>cohesive</u>, <u>unambiguous</u> <u>representation</u> of what the System <u>is</u> and <u>does</u>.
- It provides a description of
  - Requirements and
  - Technical Solution and
    - Operational Scenarios
    - System Behavior (including I/O)
    - Physical Architecture (Structure, interfaces)
    - Dynamic Simulation (requires "executable" models)
  - Verification Procedures
- MBSE is used to produce SE products
- It requires a Modeling Language (SysML) that is computer interpretable



Document centric



Minimum Required to Define System

### SysML Overview





**Descriptive Modeling** 

- General Purpose Graphical Modeling
  - Structure
  - Behavior
  - Requirements
  - Parametric
- Supports: specification, analysis, design, verification and validation
- Supports model and data interchange via XMI and the evolving AP233 standard (in-process)

### SysML is Derived from UML

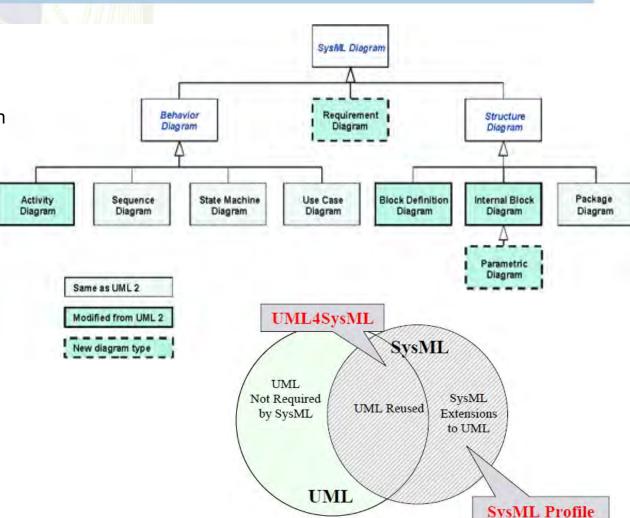
#### HPT

#### Name Change

- Class Block Definition
- Composite Internal Block

#### Removed Diagrams

- Deployment (Behavior)
- Object (Behavior)
- Component (Behavior)
- Interaction(Structure)
- Communication (Structure)
- Timing (Structure)



# How can MBSE support RD and TS



# CMMI V1.1 Continuous Representation

Requirements Development

SG1- Develop Customer Requirements

SP1.1-1 Collect Stakeholder Needs

SP1.1-2 Elicit Needs

SP1.2-1 Develop the Customer Requirements

SG-2 Develop Product Requirements

· SP2.1-1 Establish Product and Product Component Requirements

SP2.2-1 Allocate Product Component Requirements

SP2.3-1 ID Interface Requirements

SG-3 Analyze and Validate Requirements

SP2.1-1 Establish Operation Concepts and Scenarios

SP3.2-1 Establish a Definition of Required Functionality

SP3.3-1 Analyze Requirements

· SP3.4-3 Analyze Requirements to Achieve balance

SP3.5-1 Validate Requirements

SP3.5-2 Validate Requirements with Comprehensive Methods.

**Technical Solution** 

SG-1 Select Product – Component Solutions

SP 1.1-1 Develop Alternative Solutions and Selection Criteria

SP 1.1-2 Develop Detailed Alternative Solutions and Selection Criteria

SP 1.2-2 Evolve Operational Concepts and Scenarios

SP 1.3-1 Select Product Component Solutions

**SG-2** Develop the Design

SP 2.1-1 Design the Product or Product Component

SP 2.2-3 Establish a Technical Data Package

SP 2.3-1 Establish Interface Descriptions

SP 2.3-3 Design Interfaces using Criteria

SG-3 Implement the Product Design

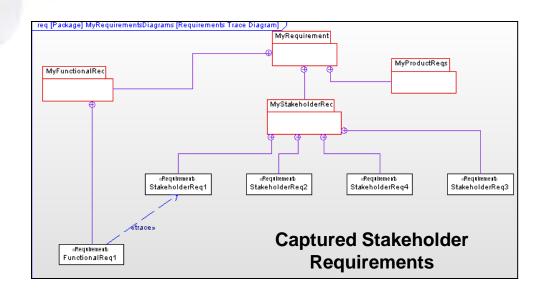
SP 3.1-1 Implement the Design

SP 3.2-1 Develop Product Support Documentation.

## Requirements Development: SG-1 Develop Customer Requirements

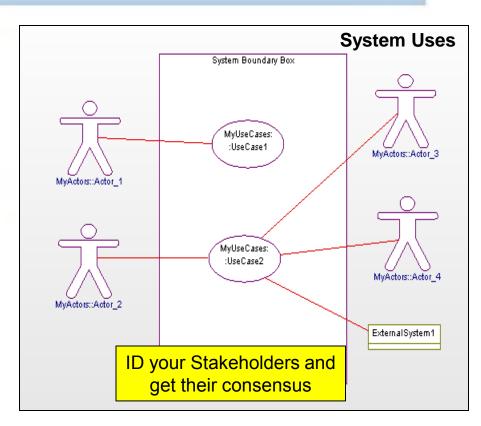
- Collect Stakeholder needs (SP 1.1-1) using the Requirements model element
- Or capture them in a requirements database and synch them with the model
- SysML can be used to capture and manage relationships between requirements
- Auto Generate
   Requirements Trace
   Matrices and Specifications

| ID     | Name              | Specification    |
|--------|-------------------|------------------|
| SR0001 | 📑 StakeholderReq1 | Req Text for SR1 |
| SR0002 | StakeholderReq2   | Req Text for SR2 |
| SR0003 | 📑 StakeholderReg3 | Req Text for SR3 |



## Requirements Development: SG-1 Develop Customer Requirements

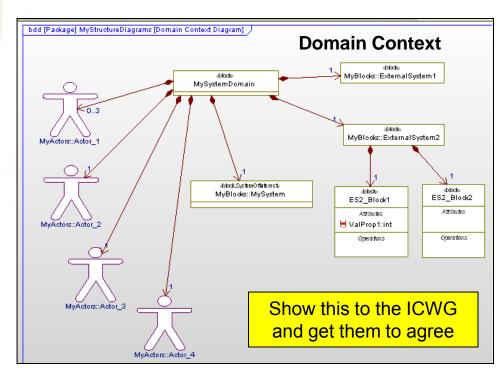
- Use "Use Case Analysis" to capture capabilities and elicit requirements from stakeholders (SP1.1-1, SP 1.1-2)
- Trace Requirements to Use Cases
- Seeing requirements in a diagram tends to draw out requirements



Diagramming and visually presenting what has been captured (SP 1.1-1)

## Requirements Development: SG-1 Develop Customer Requirements

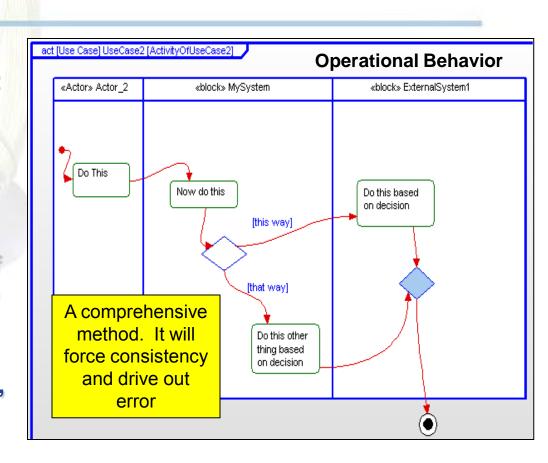
- Use Block Definition
  Diagrams (BDD) to capture
  where your system of interest
  fits, defining the Physical
  System Boundary (TS-SP 1.12, 1.2-2)
- Perform Domain Analysis to understand context and further drive out a clearer understanding of the problem that needs to be solved.
- Drive out external interfaces



Diagramming and visually presenting what has been captured (SP 1.1-1)

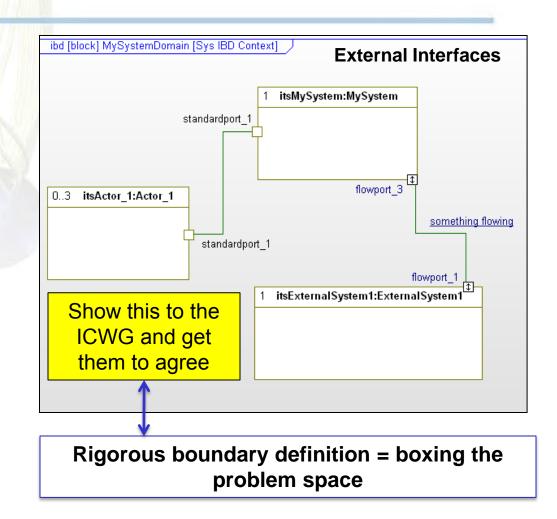
## Requirements Development: SG-3 Analyze and Validate Requirements

- Model Domain Activities with Activity Diagram (ACT) to Elicit needs and to capture behavior (SP 1.1-2)
- It starts to capture what the operational concepts and scenarios are (SP 3.1-1)
- Provides a precise definition of required functionality (SP3.2-1)
- It serves the purpose of Analyzing and validating the requirements (SP3.3-1, SP3.5-1, SP3.5-2)
- Establishes Functional System Boundary



## Requirements Development: SG-3 Analyze and Validate Requirements

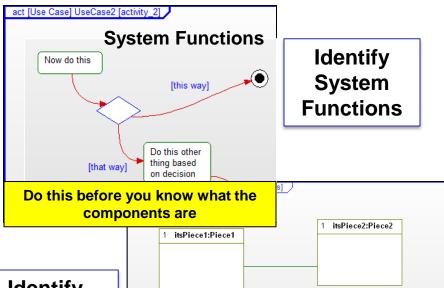
- Use an Internal Block
  Diagram (IBD) to elicit
  requirements and identify
  interface requirements (SP
  1.1-2, 2.3-1).
- Rigorous and explicit capture and documentation of external interfaces.
- Serves the purpose of Analyzing and validating the interface requirements (SG 3).
- Merge of physical and functional system boundary definition



#### HPT:

- Identify behaviors and derive functional requirements of your system and system components (SP 3.2-1)
- Use IBD to capture the arrangement and association between a selected system solution alternative.
- Identify Interface Requirements (SP 2.3-1)

Input from Technical Solution (SP1.1-2, SP2.1-1)



Identify Component Interactions 1 itsPiece3:Piece3

System Internal Interfaces

This would be done once you know what

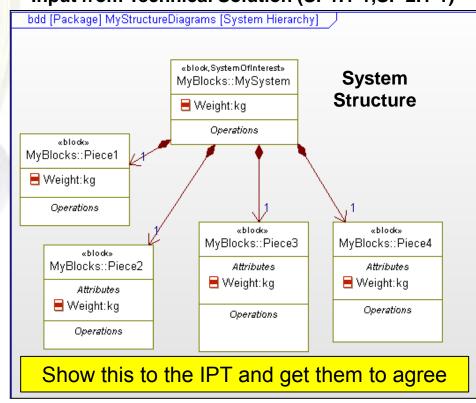
your components are

Update everything as you learn more.

#### HPT:

- Capture the Systems
   Physical Structure or
   Hierarchy with a Block
   Definition Diagram (BDD).
- If you know what these are begin Developing Product Requirements (SP2.1-1).
- Else perform Technical
   Solution Practices.
- Identify associations and quantities.
- Allocate requirements to each system component/block (SP2.2-1)

#### Input from Technical Solution (SP1.1-1,SP 2.1-1)

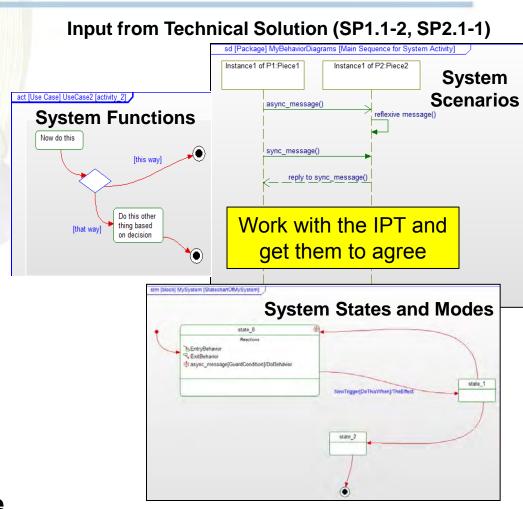


**Identify System components** 

#### HPT:

- Use Sequence Diagrams,
  Activity Diagrams and State
  Machine Diagrams to
  Identify behaviors and
  derive functional
  requirements of your
  system and system
  components (SP 3.2-1)
- This should serve as the authoritative source for describing design details
- Requirements can be directly traced to design elements in the model

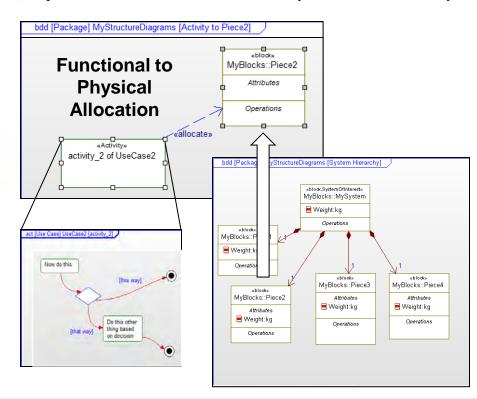
**Results in a Functional Architecture** 



#### HPT:

- Allocate Product Component Requirements to System Elements (SP2.2-1).
- This requires execution of the Technical Solution Process Area
- If modeled properly a change to the model elements will invoke a change to all diagrams and uses of that model element

Input from Technical Solution (SP1.1-2, SP2.1-1)





#### HPT:

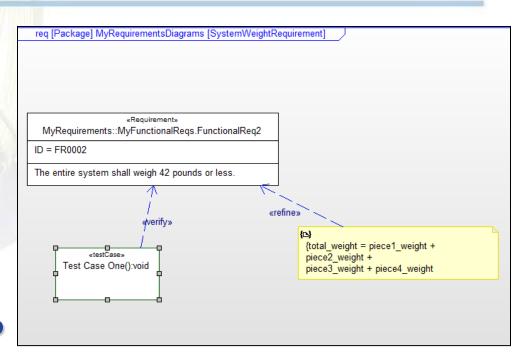
- Use a BDD and Parametric Diagrams to show allocation of product component requirements and to capture Design Constraints (SP 1.1-1, SP-2.2-1).
- Used in to define design trade offs (SP 2.4-3) and to balance the requirements (SP3.4-3)
- Parametric Diagrams
   capture how requirements
   can be analyzed (SP 3.3-1)
   for validation (SP3.5-1) and
   evaluate performance
   measures (PA EV).

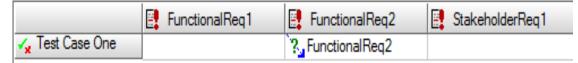
bdd [Package] MyStructureDiagrams [Analysis of Parametrics] **Input from** «block.SystemOfInterest» 9 «ConstraintBlock» MyBlocks::MySystem WeightEquation **Technical** ■ Weight:kg {□} total weight Solution async\_message() MyBlocks::Piece1 ConstraintParameter (SP1.1-2) Total:kg Attributes weight1:kg Operations weight2:kg weight3:kg weight4:kg MvBlocks::Piece4 MyBlocks::Piece2 MyBlocks::Piece3 Attributes ■ Weight:kg ■ Weight:kg Weight:kg Operations MyBlocks::MySystem.Weight:kg Total:kg weight1:k MyBlocks::Piece1.Weight:kg weight4:kg Constraints (a) total weight MvBlocks::Piece4.Weight:kg MyBlocks::Piece3.Weight:kg MyBlocks::Piece2.Weight:kg MyBlocks::MySystem.itsPiece1:Piece1 MyBlocks::MySystem.itsPiece2:Piece2 MyBlocks::MySystem.itsPiece3:Piece3 MyBlocks::MySystem.itsPiece4:Piece4 ■ Weight:kg ■ Weight:kg ■ Weight:kg ■ Weight:kg Operations Operations Operations sync\_message():void reply to sync message():void async message() reflexive message():void

## Requirements Development: SG-3 Analyze and Validate Requirements

#### HPT:

- Use Requirements Model Elements to capture Test Case Descriptions
- Use Requirements
   Diagrams to trace between
   Test Cases and
   Requirements.
- A diagram of this may help the team relate to how many tests are necessary to verify a requirements and vice versa.
- Auto generation of Verification Matrix



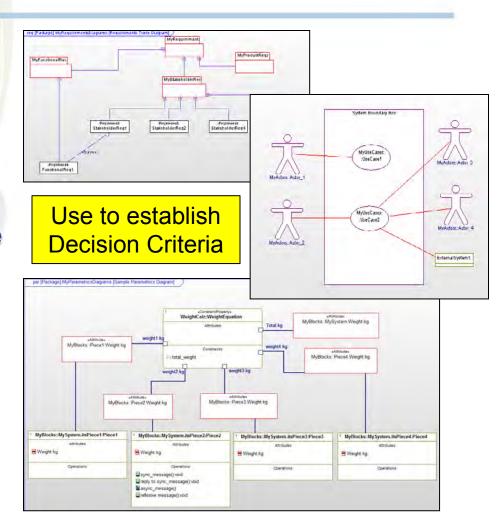


All Requirements should have Associated Verification Methods

### **Technical Solution:**

#### SG-1 Select Product - Component Solutions

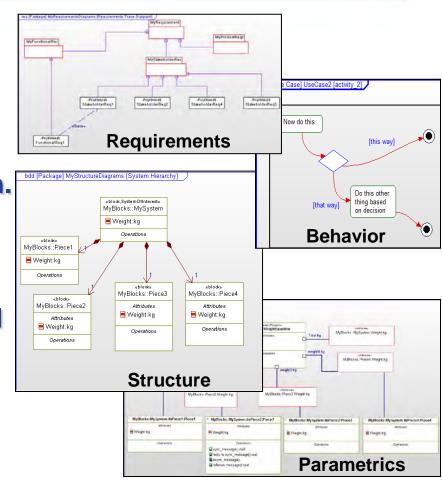
- You will need to construct behavior, cost, architecture, physical mock ups, prototypes of alternative solutions.
- Using SysML to capture a description to each alternative can help to communicate with the IPT
- The Decisions can be captured as notes in SysML
- Evaluation Criteria will likely emerge as requirements so capture them as such.



## Technical Solution: SG-2 Develop the Design

#### HPT

- requirements from the logical design to each design Alternative (SP 1.1-2)
- Use BDD and IBD to capture an abstraction of the Physical Design.
   This is the Product Architecture and the authoritative description of the design.
- The whole process is recursive till you are at the lowest level in the system hierarchy
- The System model will organize your product description data



## Technical Solution: SG-3 Implement the Product Design



- For SW products SysML and UML can be used to auto generate Code.
- For Electrical and Mechanical Systems CAD product models can be used to directly support manufacturing, assembly, inspection, and test.
- A rigorously modeled design will support resolving problems as they come up.

**Model Based Engineering Can Help** 

### **Planning Considerations**

- Use people who are open to this approach and are willing to go the extra mile. Pair them with someone who is experienced. It will accelerate the learning process and keep them from stalling out.
- Conduct a Gap Analysis
- You will need to pick a tool
- You will need a Methodology that describes how, why, when, and what to model.
- You will need to train even the most experienced Systems Engineers (Language, Tool, Methodology)
- You will want to pilot it on several projects to learn your own lessons.
- Keep it simple at first and expand to more complex modeling problems.
- Model what you know best and see if everyone really understands it the same way. (You will need to work towards this.)

### Conclusion



- Established the need to change
- Discussed how Modeling supports many of the RD and TS CMMI practices.
- It will take time and requires training and practice.
- We can't keep operating the same way.







Transdyne Corporation
CMMI Implementations in
Small & Medium
Organizations

### Using the Agile Methodology to Mitigate the Risks of Highly Adaptive Projects

Dana Roberson
Quality Software Engineer
NNSA Service Center

And Dr. Mary Anne Herndon Transdyne Corporation





### Agenda: Using the Agile Methodology to Mitigate the Risks of Highly Adaptive Projects





Risks in Highly Adaptive Projects

- Typical Management Scenarios
- Agile Software Development Methodology
- Steps for Implementing CMMI-DEV Practices in Agile Projects



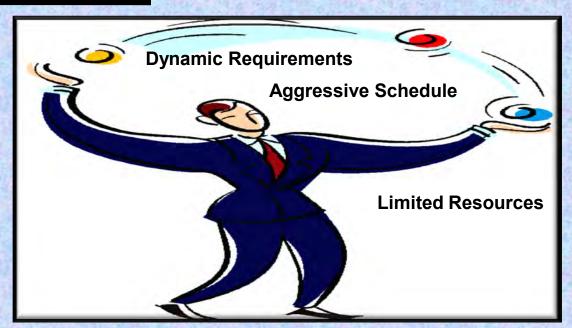
- Strategy Map for Using Agile Practices
- Benefits
- Lessons Learned



#### **Agile Methodology for Risk Management**



Transdyne Corporation
<a href="http://transdynecorp.com">http://transdynecorp.com</a>
CMMI Implementations in
Small & Medium Organizations



Using the Agile Methodology to Manage Risks of Highly Adaptive Projects

**Dynamic Requirements** 

**Aggressive Schedule** 



Impact of customer co-location on requirements management & tasking

Immediate effect of changing customer priorities & direction

Typical work performed on a fixed LOE or time & material basis







#### **Risks In Technology & Support Projects**



The requirements are ALWAYS changing.

Time and schedules are ALWAYS aggressive.

Resources will ALWAYS be tight.

To mitigate these risks you need processes that address these risks to allow rapid adaptation.



### Scenario for Risk Management Practices in Small Businesses



Small businesses often function in focused markets as:

- Suppliers of specialized on-site technical services, key personnel, applications or products
- Domain specialists
- Staff augmentation

These focused markets may not provide needed revenue or market share growth to readily prosper in today's economy.



Costs of improving project and risk management practices are considered key investments in these vulnerable cash flow environments.

Both near and long term cash flow analysis typically includes factors such as:

- Customer base stability & revenue cycles
- Projected revenue growth
- Costs of acquiring appropriate resources to improve management practices, such as training, process engineers and collaborative software and hardware.





### Scenario for Implementing Risk Management Practices in Small Businesses (continued)





Understanding and improving project management and risk management practices is a key factor in revenue growth.

Planning improvements typically includes assessment of critical factors such as:

- Required resources (available staff, feasible schedule, platforms, facilities, collaborative tools)
- Past performance data (costs, schedules, lessons learned)
- Training in the domain and software development method (Agile)
- Risk identification and impact assessment
- Risk mitigation



A practical knowledge base useful for improving management practices can be provided by process models, such as CMMI and ISO 9000. Obtaining CMMI benchmarks and ISO 9000 certifications are often stepping stones to expand government and commercial customers.

Selecting and implementing any process and life cycle models is both costly and can be risky as there are no guarantees of success on-site with the customer.





#### Scenario for Implementing Risk Management in Small – Medium Businesses (continued)



Planning a process improvement strategy typically includes identifying problematic projects with typical issues such as:

- Limited resources and ambitious schedules
- Lack of experience and staff training
- Excessive staff turnover rate
- Stability of current customer base
- Projection of market growth
- Over commitment of key staff
- Inaccurate planning data for costs and schedule



Implementing a process improvement strategy, small businesses should customize a path of small, adjustable steps.

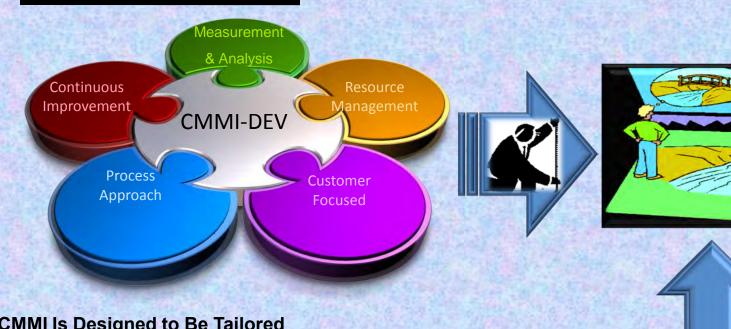
An example of a path of small steps is a hybrid approach of improving project and risk management practices in CMMI-DEV first.



The next step is a selection of a life cycle model that is suitable for the work requirements, location and level of customer participation.

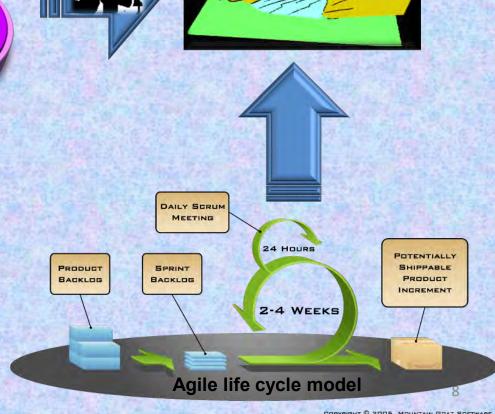


#### Building Bridges Using CMMI-DEV and Agile to Manage Risk



**CMMI Is Designed to Be Tailored** to Your Business Environment.

- √ Fully align process improvement with your business goals
- ✓ Look at what you are actually doing,
- √ If a "good fit" document and follow
- ✓ Leverage off existing activities e.g. **Agile**
- ✓ Promote maximum flexibility and efficiency in your process improvement approach
- ✓ Emphasize measurement and analysis

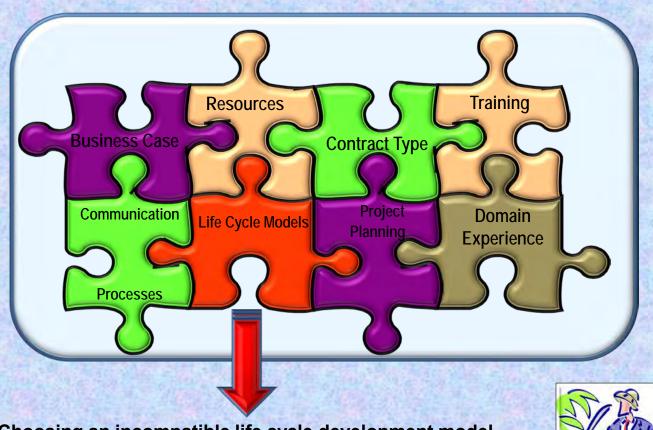




### Key Process Improvement Factors & Sources of Risks



#### All KEY process improvement factors introduce sources of risks to developers!



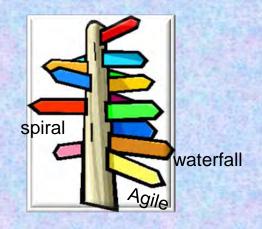
Choosing an incompatible life cycle development model impacts all other key process improvement factors.



#### Sources of Risks in Life Cycle Models







Waterfall

cycle times

impact of changing requirements

direct end user involvement

**Spiral** 

cycle times

impact of changing requirements

direct end user involvement

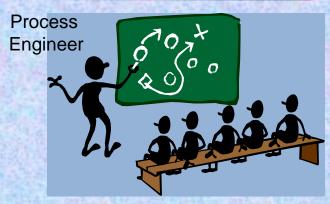
Agile

inadequate training customer awareness management advocacy



#### Practice Implementation Across Small Organizations

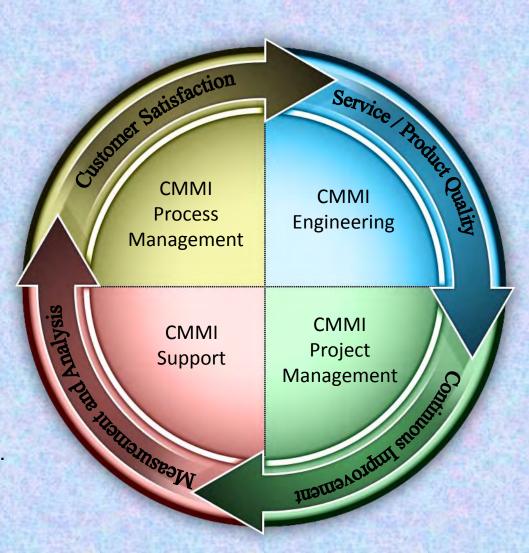




Organization

### Framework of the CMMI-DEV model provides:

- Increases in implementation
   efficiency due to redundancy
   in model functions, such as
   Project Management & Support
   Process Areas and generic practices.
- Minimal opportunities for conflicts with customer, staff and resources with adequate model understanding



11



#### **Steps for Implementing Risk Management** with CMMI-DEV & Agile





#### **Understand the Risks**

**Key growth Investments:** 

Process & Agile training Collaborative H/W & S/W Process engineer support

#### **Lessons Learned**

- √What did we do well?
- √Where were we lucky?
- √What do we need to improve?



Develop Agile project plan



**Impact** Metrics

Cost Schedule Technical

Status risks

Identify risks:

- project specific
- •technical impacts
- mitigation plans
- •customer involvement

High Medium Low

Risk

Template



plans

**Evaluate business opportunity** 

"Risk of winning"

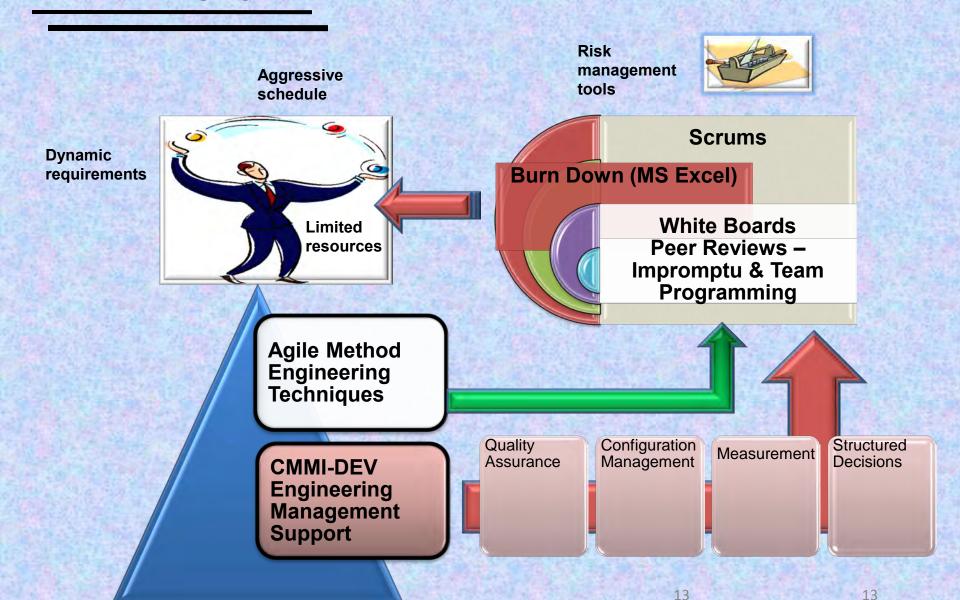


**Contract type New customer Technical complexity Staff** 



### Strategy Map for Implementing Risk Management Using Agile and CMMI-DEV







#### **Risk Reduction Solution - Process Improvement**



Risk reduction is NOT fighting fires or "just in time solutions."

- It is simply a way of looking at how we can do our work better.
- A series of actions taken to identify, analyze and improve existing processes.
- These actions often follow a specific methodology or strategy to create successful results.

Reduce variation.

- Remove activities that have no value to the organization.
- Improve customer satisfaction.
- Process improvement is important as it has often been said that process accounts for 80% of all problems while people account for the remaining 20%.

Recognize and document best practices.

- Provide lessons learned.
- Encourage staff members to contribute!



#### What are Best Practices and Benefits?





Best practices are effective, high-leverage technical and management <u>PROCESSES</u> that have been implemented and proven on successful projects.

| Examples of Best Practices              | Benefits                                     |  |
|---|--|--|
| Proven Models – i.e. CMMI-DEV, ISO 9001 | Risks are reduced & mitigated                |  |
| Project Planning                        | Repeatability is achieved                    |  |
| Measurement and Control                 | Clarity and understanding are                |  |
| Peer Reviews                            | increased                                    |  |
| Risk Management                         | Common terminologies and                     |  |
| Quality Assurance                       | consistent styles are developed and followed |  |
| Status Reporting                        |  |  |
| Configuration Management                | XXIII  |  |
| Agile Software Development              |  |  |

#### Typical "Roadblocks and Hurdles" to Process Improvement

#### **Resistance to Change**

Lack of Commitment and Resources

"We tried process improvement before, and it didn't buy us anything."

"CMMI /TQM/Agile/Lean Six Sigma/ and best practices are just another fad."



"Who's paying for it? If it isn't paid for, we're not doing it."

"I'm retiring/transferring from this job soon, I don't have to get involved."

Developers don't have the time because there is so much rework.



# **AGILE Software Development Methodology**

- ✓ Activities are known as 'timeboxes'.
- ✓ Each iteration passes through a full software development cycle, including:

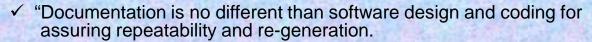
planning,

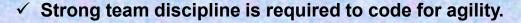
requirements analysis,

design,

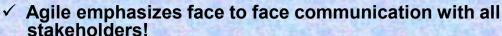
unit tests, Quality Assurance testing,

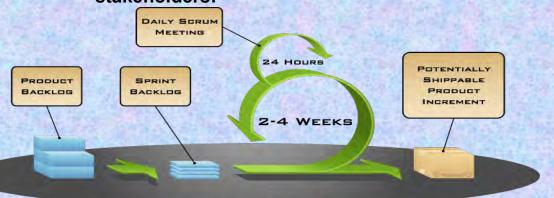
coding until the unit tests pass and a working product is finally demonstrated to stakeholders.





✓ At the end of each iteration, stakeholders re-evaluate project priorities with a view to optimizing their return on investment.









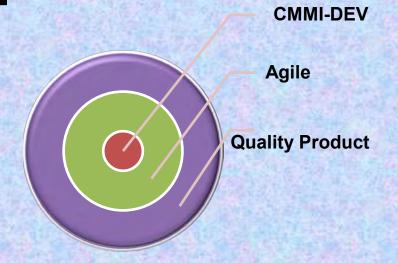




# Agile - Navigating Class IV Rapids (AKA Risk Reduction)







- Agile development methods minimize risk by developing software in multiple 'iterations' of short time frames
- □ Each iteration passes through a full software development cycle
- ☐ In our Agile projects, SCRUM Boards, Burndown charts and other project and working artifacts were defined and identified as "CMMI artifacts".
- ☐ Face to face communication & EA reviews ensure peer review.
- At the end of each iteration, stakeholders reevaluate project priorities and risks.





# Agilizing CMMI – SCRUM and CMMI

✓ Incorporating CMMI Processes
 Tailoring processes to incorporate Agile
 iterations
 Mapping CMMI SPs to Agile iterations and
 artifacts
 Monitoring and controlling projects
 requirements and changes
 testing
 defects



✓ Using Agile at our shop

#### **Software Tools**



# Agile & CMMI-DEV Processes

(Process Asset Library)

Visual Source Safe
Configuration Management
Source Control

**Visual Studio** 

**Development Environment** 

**SQL Management Studio** 

**Development environment** 

**Enterprise Architect** 

Requirements management Requirements traceability

**Axosoft OnTime** 

**Defect Management** 

**Defined processes** 

**Scrums** 

**Scrum Boards** 

**Sprints** 

Burn Down - (MS Excel)

**White Boards** 

**Peer Reviews** 

**Team programming** 

**Performance metrics** 





#### Where to Start?

- Look at what you have in place
  - What are you doing well right now
- Establish your SEPG
- Tailor the CMMI process descriptions to map to current processes
  - "By-in" by Software Engineering and Management
  - PAL
- Develop processes for things you are not doing now
- Discuss with Software Engineering Team
- Train the Team!



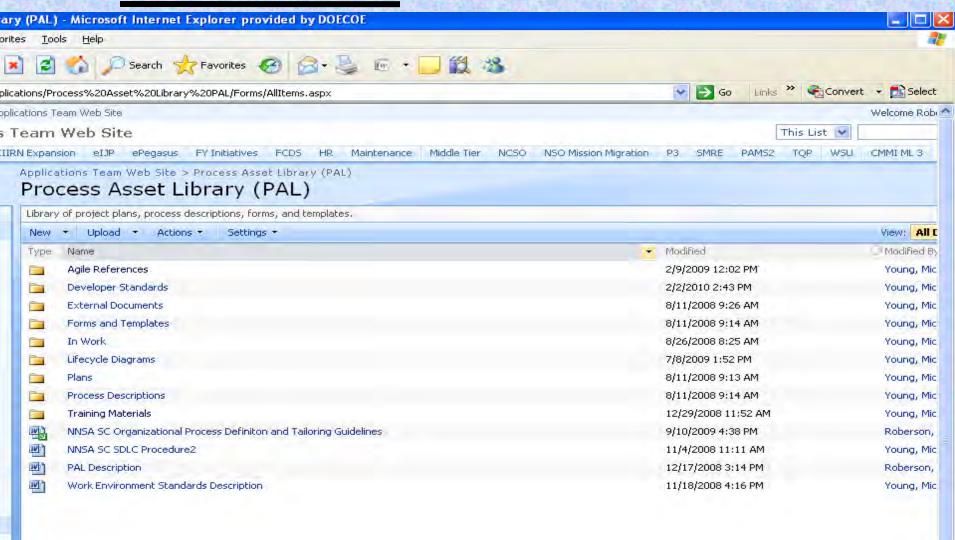
- Follow up on how processes are being implemented and
- Modify if necessary to get a "best fit"!





## Process Asset Library – Processes and Standards







# **Process Descriptions Based on how We Do Business**



|    | 直接 10 mm (10 mm) (10 |                    |                |
|----|--|--------------------|----------------|
|    | PD_2.4_Sprint Review Meeting   | 6/29/2009 11:53 AM | Young, Michael |
| W) | PD_3.0_Requirements Development  | 6/29/2009 10:42 AM | Young, Michael |
| W) | PD_3.3_Manage Requirements   | 6/29/2009 10:53 AM | Young, Michael |
| W  | PD_4.0_Peer Review   | 7/1/2009 4:26 PM   | Young, Michael |
|    | PD_5.0_Project Support   | 8/10/2009 3:28 PM  | Young, Michael |
| W) | PD_5.1_CM Capability   | 8/10/2009 1:31 PM  | Young, Michael |
| W) | PD_5.3_Track Change Requests   | 8/10/2009 1:31 PM  | Young, Michael |
| W) | PD_5.4_Manage Baselines  | 8/10/2009 1:32 PM  | Young, Michael |
| W  | PD_5.5_Configuration Audits  | 8/10/2009 1:32 PM  | Young, Michael |
| W  | PD_Deployment  | 5/11/2009 2:23 PM  | Young, Michael |
| W) | PD_PM_Lifecycle  | 5/26/2009 3:13 PM  | Young, Michael |
|    | PD_Release Management  | 10/26/2009 8:54 AM | Young, Michael |



## **Process Area Description**



# Enterprise Information Technology Services Applications Development Process

| Process Area: RQDM (Requirement Development and Management) (RE   |                                | Specific Goal: (All SGs)                          |                  |  |  |  |  |  |
|---|--------------------------------|---|------------------|--|--|--|--|--|
| Summary: This process outlines ho validates requirements for a software Requirement Meetings, and the Enterproject sprint cycle to accomplish the | development<br>rprise Architec | project. The department ut                        | tilizes Customer |  |  |  |  |  |
| Brease Area BOC: Walker   | Approval:                      |   |                  |  |  |  |  |  |
| Process Area POC: Joseph<br>Robinson  | Date:                          |   |                  |  |  |  |  |  |
| Revision History:   |                                |   |                  |  |  |  |  |  |
| Revision Level  | Date                           | Description                                       | Change Summary   |  |  |  |  |  |
| PD_RDQM_2.1.2_Requirements Development  | 5/26/09                        | Initial document                                  | N/A              |  |  |  |  |  |
| PD_3.0 Requirements Development   | 6/29/09                        | Revised names and<br>numbers to fit new<br>model. |                  |  |  |  |  |  |
|   |                                |   | 1                |  |  |  |  |  |
| Process Area Overview   |                                |   |                  |  |  |  |  |  |



Standards – Developed by TWG within the SEPG available to all developers on SharePoint Site

This process area applies to all software development projects under the responsibility of the Information

- ✓ Work Environment Standards
- ✓ Web Design and Usability Guidelines
- ✓ Coding Standards

Technology Department (ITD) Applications Development group.





# **Process Descriptions – Diagrams**



Development
Initial Planning Cycle
Project Backlog
EA
Management –
Tracked in EA through testing



# **Process Descriptions - Mapping**



Development
Initial Planning Cycle
Project Backlog
EA
Management –
Tracked in EA through testing



# Agile Focus on Quality - Built-In





#### 1 Executive Summary

This Quality Assurance Assessment Report documents the details of an onsite Process Area quality audit. The audit was performed by Software Quality from April 9, 2009, through April 15, 2009

An analysis of the ITD software and project processes, documentation, and work products was performed. This included review of documentation, overarching procedures, Sprint retrospectives and burn down charts, notes, meeting minutes, and interviews. The analysis was based on a tailored mini-appraisal or "gap analysis," as described in the CMMI SCAMPI B model.

The overall rating of this assessment indicated that the processes chosen to be audited were partially-to largely-implemented. However, several process areas were rated and not yet as they are ML 3 and are still in the implementation stage. Assessment results will be reported to the associated project leaders, team leaders, and selected management.

| Process Area                          | Ranking         |
|---------------------------------------|-----------------|
| Measurement and Analysis              | 9 FI            |
| Process and Product Quality Assurance | 7.5 LI          |
| Configuration Management              | NY              |
| Decision Analysis and Resolution      | 9 FI            |
| Project Planning                      | 9 FI            |
| Project Monitoring and Control        | 8.4LI           |
| Integrated Project Management         | 8.3 LI          |
| Risk Management                       | 8.2 LI          |
| Requirements Management               | 6.4 LI          |
| Requirements Development              | NY              |
| Technical Solutions                   | NY              |
| Product Integration                   | 113.8           |
| Verification and Validation           | 8.8 LI          |
|                                       | OVER ALL 8.3 LI |

Assessor: Dana Roberson
Updated for
Factual Accuracy: Rebecca Dickens

Corrective actions and process improvements, based on the assessment results, will be documented and monitored. A follow-up on the corrective actions derived from the assessment results will take place within three months of acceptance of this report.

#### **Agile Resources to Develop Quality Products**



#### Sprint Plan

Testing is built into each sprint

#### Scrum

- Assign tasks to resources
- Reassign based on burndown

#### Sprint Planning

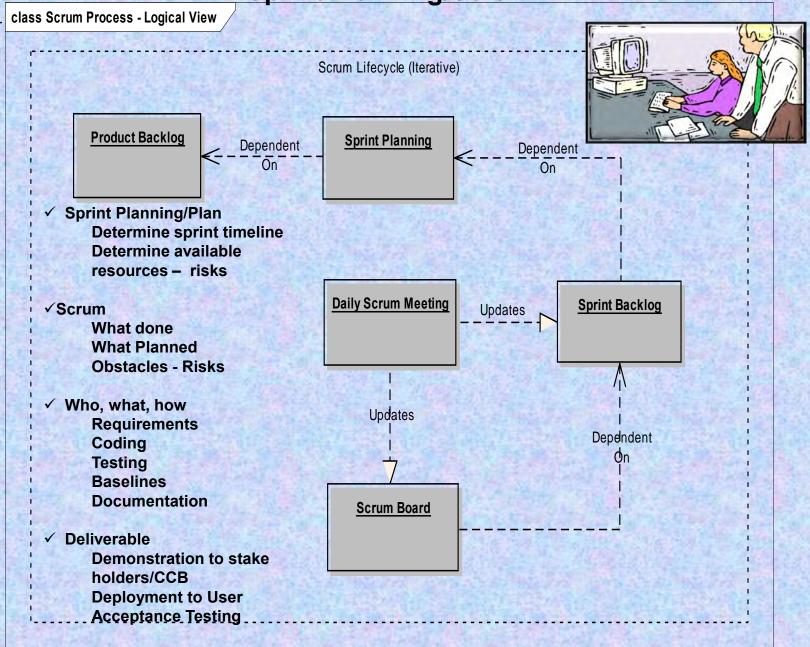
- Requirements
- Available resources
- Development & QA

#### Defect Workflow

- Maintenance resources
- QA assignment



**Sprint Planning/Scrum** 





# **Sprint Planning**



- Sprint Planning/Plan
  - Determine sprint timeline
  - Determine available resources -
- Who, what how
  - Requirements
  - Coding
  - Testing
  - Baselines
  - Documentation
- Deliverable
  - Demonstration to stake holders/CCB
  - Deployment to User Acceptance Testing



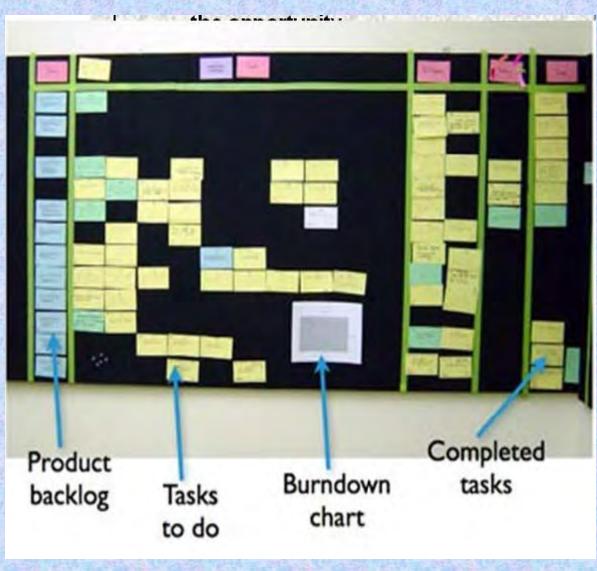


## **Design Process**





- Project Plan
  - Overall Design
- Sprint Planning
- Daily Scrum
  - Developer review (Peer)





# **Gathering, Reviewing and Testing the Requirements**

#### **Enterprise Architect**



Requirements
Definition (Enterprise
Architect)

Requirements Review (EA export to web interface)

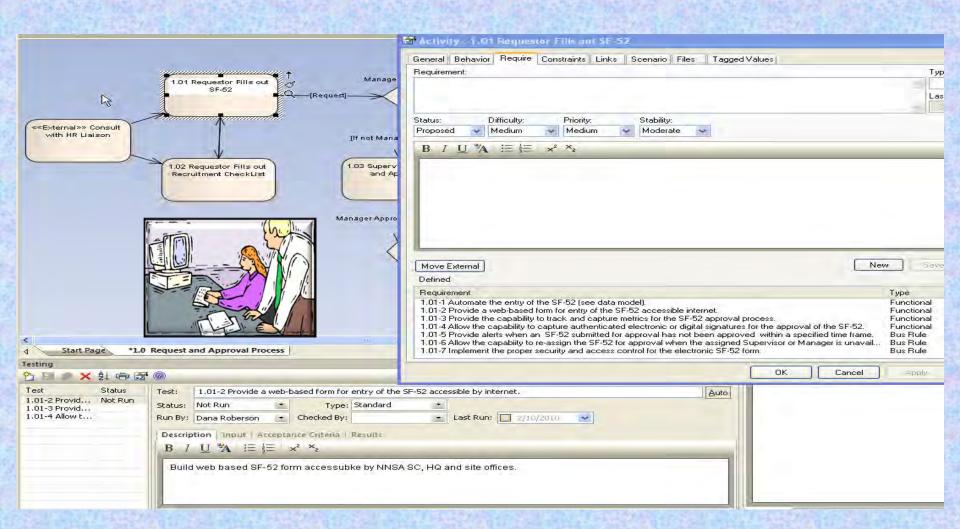
- Peer Review
- Developer review
- CCB review

Requirements tied to activities and tests for traceability



## Gathering and Managing Requirements - BA & QA

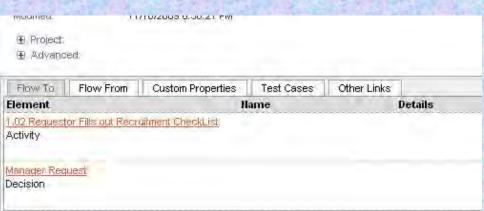






# SEIPartner Requirements Management and Tracking - SE and Customer









## **Coding/Unit Testing & Documentation**



#### Development

- Development of Functional unit on DEV environment
- Get latest of all code, unit test
- Check in Code to Visual Source Safe
- At prescribed interval, build full project, deploy to internal
- testing environment
- Automated Baseline Capture developed by team



- Well commented code
- Document changes to other developers code
- Context sensitive help in development environment and customer environment
- Notes and resolutions in Axosoft OnTime

```
/ *** * Object: StoredProcedure [dbo].[rsARHearing]
                                                         Script
 SET ANSI NULLS ON
 SET QUOTED IDENTIFIER ON
 -- Author: Shane Seery
 -- Create date: June 2, 2009
    Modified date: August 11, 2009
 -- Description: Retrieve data for the AR Hearing Report
  -- added hearing request and deny dates dsr
ALTER PROCEDURE [dbo] [rsARHearing]
     @StartDate datetime,
     @EndDate datetime
 AS
BEGIN
     SET NOCOUNT ON:
```



## Developer Interaction with QA reduces Risk



Testing is built into the development cycle

Early and frequent delivery ensures adequate time for feedback and reduces risk

Agile benefits the IT department assisting in quicker better quality and reduced work

Stressing repeatable processes for project management



# Internal Testing (DEV/QA)

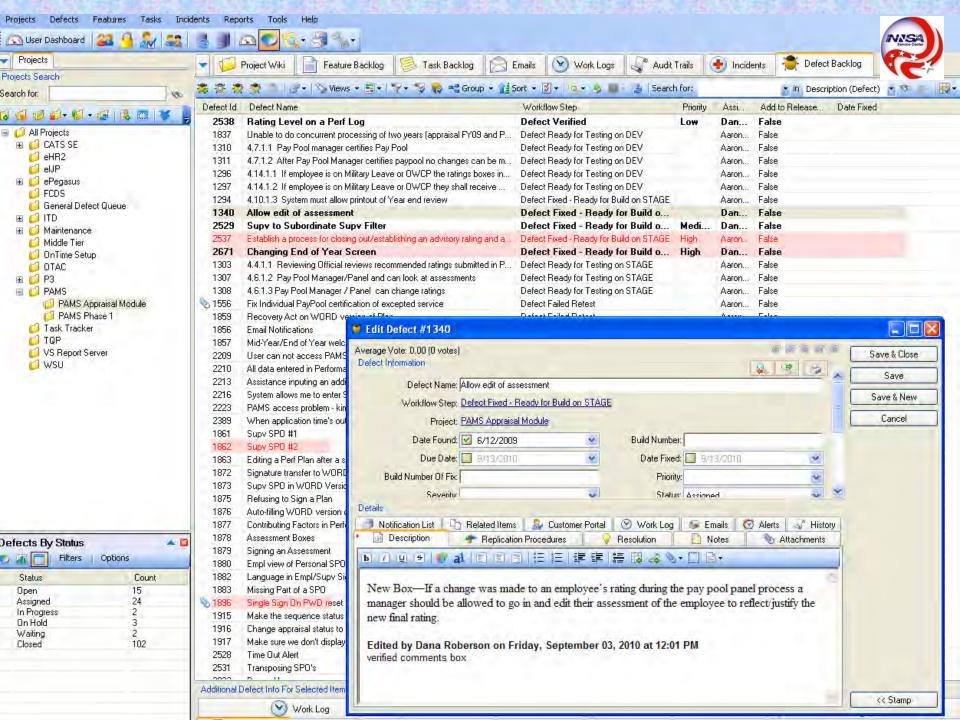
- Developer notifies QA of functionality ready for testing
- Defect found by QA entered into Axosoft Ontime
- Developer fixes defect rebuilds- workflow in Ontime Ready for testing on TEST
- "Defect Fixed" or "Failed Retest"



User Acceptance Testing (STAGE)



**Production (PROD)** 





# **Acceptance Testing and Traceability**



# **Acceptance Tests**

| Name   | Object   | Current<br>Status | Descriptio<br>n  | Input   | Acceptance<br>Criteria   |
|--|--|-------------------|--|---|--|
| PAMS 1.1.1.2 Supervisor<br>can initiate Performance Plan<br>for employee   | 1.1.1 Create<br>Employee<br>Performance<br>Plan - SPOs | Not Run           | If employee is<br>absent,<br>supervisor can<br>create<br>performance<br>plan for them.             | Supervisor logs into PAMS<br>Supervisor selects Employee<br>Supervisor selects Plan<br>Supervisor selects SPO from<br>Library for edit or<br>Supervisor creates SPO<br>Supervisor saves SPO | employee plan created  |
| PAMS 1.1.1.3 An employee<br>can have no more than two<br>Open and Active<br>Performance Plans                              | 1.1.1 Create<br>Employee<br>Performance<br>Plan - SPOs | Not Run           | Employee has<br>Active and<br>Detail plan -  | employee logs into PAMS employee selects Plan Employee selects SPO from Library for edit or Employee creates SPO Employee saves SPO Employee tries to do this three times                   | No more than two<br>Performance Plan(S)<br>created                                 |
| PAMS 1.1.1.5 An Employee<br>can only have two<br>Supervisors (one of Record<br>and one of Detail)                          | 1.1.1 Create<br>Employee<br>Performance<br>Plan - SPOs | Not Run           | An Employee<br>may have a<br>supervisor of<br>record and if<br>necessary a<br>Detail<br>Supervisor | Attempt to assign two supervisors to one employee   | Can assign Detail<br>Supervisor, if Active<br>Performance Plan is in-<br>activated |
| PAMS 1.1.6 Only Performance Plans with reporting period of 90 days or more can be evaluated and assessed for Final Rating. | 1.1.1 Create<br>Employee<br>Performance<br>Pian - SPOs | Not Run           | Performance<br>Plans must<br>have a<br>reporting<br>period of 90<br>days or more<br>before they    | Attempt to rate Performance<br>Plan of employee with less than<br>90 days on job  | System will give warning<br>that employee has not<br>worked at least 90 days       |



# **Monitoring and Controlling by Establishing Measurement** selPartner Objectives



The NNSA SC ITD **Apps Team** maintains the Measurement and Analysis Plan (MAP).

MAP defines the process performance measurement foundation established by applying the Goal Question Metrics (GQM) to the **Applications Mission** Statement

The Apps Team leverages higher maturity level process performance management tools to:





**Build process** performance databases using statistical process control (SPC).

Track variance analyses (control charts with standard deviations)

Analyze defects, accuracy of resource estimation, development and maintenance productivity and customer satisfaction

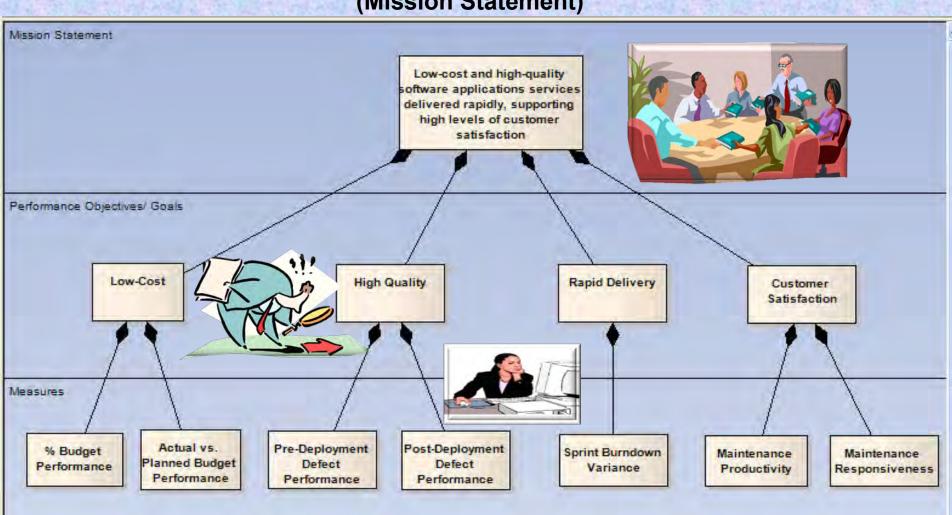


## **Measurement Objectives**



Low-cost of high-quality software applications and services, delivered rapidly, which supports high levels of customer satisfaction.

(Mission Statement)





# Monitoring and Controlling via Sprint Burndown Charts

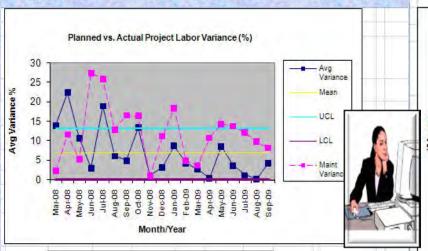


|        |   |  |               |  | 27-Jul   | 28-Jul | 29-Jul | 30-Jul |    | 3-Aug | -  | 5-Aug | 6-Aug | 7-Aug     |
|--------|---|--|---------------|--|----------|--------|--------|--------|----|-------|--|-------|-------|-----------|
|        |   |  |               |  | 1        | 2      | 3      | 4      | 5  | 6     | 7  | 8     | 9     | 10        |
| Req ID | Requirement Description   | Item Status  | Hours (Est)   |  | 115      | 93     | 81     | 67     | 66 | 65    | 59   | 53    | 33    | 23        |
| 20     | Put Axosoft button in PAMS  | Complete   | 1             |  | 1        | 1      | 1      | 0      | 0  | 0     | 0  | 0     | 0     | 0         |
| 30     | Rework Apprasail status report  | Pending  | 3             |  | 3        | 3      | 3      | 3      | 3  | 3     | 3  | 3     | 3     | 3         |
| 40     | Create report notification for signature status                               | Pending  | 8             |  | 8        | 8      | 8      | 8      | 8  | 8     | 8  | 8     | 8     | 8         |
| 50     | Make report framework work  | Pending  | 8             |  | 8        | - 8    | - 8    | 8      | 8  | 8     | 8  | 8     | 8     | 8         |
| 60     | 1222 - Add 'Recovery Act' checkbox to<br>SPO                                  | Complete   | 4             |  | 4        | 0      | 0      | 0      | 0  | 0     | 0  | 0     | 0     | 0         |
| 70     | 1345 - Make red and green buttons<br>readable by the color blind              | Pending  | 3             |  | 3        | 3      | 3      | 3      | 3  | 3     | 3  | 3     | 3     | 3         |
| 80     | 1221 - Remove 'Check if Supervisor SPO is applicable' checkbox                | Pending  | 1             |  | 1        | 1      | 1      | 1      | 1  | 1     | 1  | 1     | 1     | 1         |
| 90     | 1296 - If employee on Military<br>Leave/OWCP the ratings boxes greyed<br>out. | Complete   | 2             |  | 2        | 2      | 2      | 2      | 2  | 2     | 2  | 2     | 0     | 0         |
| 100    | Check and set up interface items  | Complete   | 12            |  | 12       | 12     | 12     | 6      | 6  | 6     | 6  | 6     | 0     | 0         |
| 110    | Rework  | Complete   | 33            |  | 33       | 27     | 27     | 24     | 23 | 23    | 23   | 17    | 8     | 0         |
| 120    | Misc  | Complete   | 10            |  | 10       | 10     | 10     | 6      | 6  | 6     | 0  | 0     | 0     | 0         |
| 130    | Requirements  | Complete   | 12            |  | 12       | 5      | 1      | 1      | 1  | 1     | 4  | 1     | 0     | 0         |
| 140    | Testing   | Complete   | 12            |  | 12       | 12     | 4      | 4      | 4  | 4     | 4  | 4     | 2     | 0         |
| 150    | Write Test Scripts  | Complete   | 6             |  | 6        | 1      | 11     | 1      | 1  | 0     | 0  | 0     | 0     | 0         |
|        | PAMS2 Burndown (Sprint 12)  | В  | irndown Calc  |  | 115      | 103.5  | 92     | 80.5   | 69 | 57.5  | the same of the sa | 34.5  | 23    | 11.5      |
| 20     |   | Hrs  | /Day Baseline |  | 11.5     |        |        |        |    |       | % Work<br>Completed  |       |       | 71.304348 |
| 0 m    |   |  | out buseling  |  |          |        |        |        |    | -4    | Sprint<br>Velocity   |       |       | 9.2       |
| ğ es — | Sundown Season  | Labor Hours Available  |               |  | 112      |        |        |        | 17 |       |  |       |       |           |
| # zz   |   | Но   | ours Not Used |  | -3       |        |        | 7      | 1  | 7     |  |       |       |           |
| b      | 2 3 4 5 6 7 5 9 10<br>fitte (demaining (Days)                                 |  |               |  |          |        |        | V      |    |       |  |       |       |           |
| 25.69  | AND THE STATE OF STREET   | MINE AND ADDRESS OF THE PARTY O | CAN-STEE      |  | EST PAIN | 1      | 3      | 1      | -  |       |  |       |       | CHARLE .  |



# **Tracking Progress Across Sprints**





|       | 35 ] |   |           |           |   |   |   |   |   | 11.00      |
|-------|------|---|-----------|-----------|---|---|---|---|---|------------|
|       | 25 - |   |           | . /       | * |   |   |   | - | - Velocity |
| Sinot | 20 - |   | . 1       | $\bigvee$ | 1 |   |   |   | _ | Mean       |
|       | 15   | ~ | $\bigvee$ | *         | 1 | س |   |   |   | UCL        |
|       | 5 -  |   | •         |           |   | • | * | - | _ | -LCL       |
|       | 0 +  |   |           | -         |   |   |   |   |   |            |

| Month/<br>Year | Planned<br>Project<br>Hours | Actual<br>Hours | Variance<br>% | Mean<br>(Avg) | UCL   | LCL | Maint %<br>Variance | Monthly<br>Status (RYG) |    |
|----------------|-----------------------------|-----------------|---------------|---------------|-------|-----|---------------------|-------------------------|----|
| Mar-08         | 2880.00                     | 2477.60         | 13.97         | 6.98          | 13.32 | 0   | 2.42                | G                       |    |
| Apr-08         | 2250.00                     | 1745.00         | 22.44         | 6.98          | 13.32 | 0   | 11.72               | Y                       | M  |
| May-08         | 2784.00                     | 2484.00         | 10.78         | 6.98          | 13.32 | .0  | 5.41                | G                       | be |
| Jun-08         | 2596.00                     | 2517.50         | 3.02          | 6.98          | 13.32 | 0   | 27.49               | G                       |    |
| Jul-08         | 3204.00                     | 2598.00         | 18.91         | 6.98          | 13.32 | 0   | 26.00               | G                       |    |
| Aug-08         | 2047_00                     | 1920.00         | 6.20          | 6.98          | 13.32 | 0   | 12.92               | G                       |    |
| Sep-08         | 1824.70                     | 1916.00         | 5.00          | 6.98          | 13.32 | 0   | 16.62               | G                       |    |
| Oct-08         | 2693.00                     | 2332.00         | 13.41         | 6.98          | 13.32 | 0   | 16.49               | G                       |    |
| Nov-08         | 2370.00                     | 2346.00         | 1.01          | 6.98          | 13.32 | 0   | 1.04                | G                       |    |
| Dec-08         | 2259.00                     | 2166.00         | 3.26          | 6.98          | 13.32 | 0   | 11.24               | G                       |    |
| Jan-09         | 2583.00                     | 2357.00         | 8.75          | 6.98          | 13.32 | .0  | 18.50               | G                       |    |
| Feb-09         | 2753.00                     | 2872.00         | 4.32          | 6.98          | 13.32 | 0   | 4.90                | G                       |    |
| Mar-09         | 2321.00                     | 2258.00         | 2.71          | 6.98          | 13.32 | 0   | 3.75                | G                       |    |
| Apr-09         | 2857.00                     | 2842.00         | 0.53          | 6.98          | 13.32 | 0   | 10.80               | G                       |    |
| V-, 00         | 2709.00                     | 2555 00         | 0.00          | 6.00          |       |     | 11.11               | G                       |    |

| Month/Year | Sprint<br>Velocity | Mean<br>(Avg) | UCL   | LCL  | Monthly<br>Status<br>(RYG) |  |
|------------|--------------------|---------------|-------|------|----------------------------|--|
| Apr-08     | 13.32              | 14.33         | 32.66 | 0.00 | G                          |  |
| May-08     | 16.42              | 14.33         | 32.66 | 0.00 | G                          |  |
| Jun-08     | 17.89              | 14.33         | 32.66 | 0.00 | G                          |  |
| Jul-08     | 10.34              | 14.33         | 32.66 | 0.00 | G                          |  |
| Aug-08     | 21.69              | 14.33         | 32.66 | 0.00 | G                          |  |
| Sep-08     | 22.36              | 14.33         | 32.66 | 0.00 | G                          |  |
| Oct-08     | 15.53              | 14.33         | 32.66 | 0.00 | G                          |  |
| Nov-08     | 29.71              | 14.33         | 32.66 | 0.00 | G                          |  |
| Dec-08     | 24.50              | 14.33         | 32.66 | 0.00 | G                          |  |
| Feb-09     | 18.30              | 14.33         | 32.66 | 0.00 | G                          |  |
| Mar-09     | 10.97              | 14.33         | 32.66 | 0.00 | G                          |  |



## **Maintaining QA Assessments**



| Obj                  | ective:  | Ensure that effective controls are in place for the coordination and implement<br>changes to software and its components.   | istion of |  |  |  |  |  |  |
|----------------------|--|---|-----------|--|--|--|--|--|--|
| Req                  | uirenenis:   | Shall include:  A set of activities for defect and enhancement identification, prioritization and selection; document and code version tracking and control; and software installation tracking.  |           |  |  |  |  |  |  |
| Арр                  | readh:   | Determine the existence of a Software Configuration Management Plan (SCMP), either as a standalone document or embedded in another document, and ensure that specifies, as applicable, the following:  Change control  Version control  Configuration item identification and classification  Issues management |           |  |  |  |  |  |  |
| Crit                 | eria:  |   | Rank      |  |  |  |  |  |  |
| 1.                   | All softwa   | re components and products to be managed have been identified.  | 9         |  |  |  |  |  |  |
| 2.                   | Authority  | for change is defined,  | 9         |  |  |  |  |  |  |
| 3.                   |  | r all identified work products are established and the integrity is maintained.   |           |  |  |  |  |  |  |
| 4.                   |  | work products are tracked and controlled.   |           |  |  |  |  |  |  |
| 5.                   | the first day of the second  | reporting, tracking, and resolving issues is defined.   | 9         |  |  |  |  |  |  |
| 6.                   | The state of the s | o the source tode can be linked to an associated issue.   | 9         |  |  |  |  |  |  |
| 7.                   |  | ciated with the software product are tracked and maintained.  | 9         |  |  |  |  |  |  |
| 8.                   | The second second second second  | f the software product are tracked and maintained and a listing of the different<br>available such that a previous release of the product can be made available.  | 9         |  |  |  |  |  |  |
| 9.                   | Processes  | are followed.   | 9         |  |  |  |  |  |  |
| 10,                  | Periodic n   | infiguration assessments and reviews are conducted and documented.  | 9         |  |  |  |  |  |  |
|                      | 4-1-1-1-1  | SCORE:  | 2 (FI)    |  |  |  |  |  |  |
| Tail                 | oring:   | Discuss here any tailoring of the assessment was allowed in this focus area j<br>application under review.  | for the   |  |  |  |  |  |  |
| Records<br>Reviewed: |  | List all the records that were reviewed.  VSS history  Project Log  CIMP  Sprint - Backlog  |           |  |  |  |  |  |  |
| -                    | rviews<br>ducted:  | List diviterness that were conducted (do not include the names of individual instead titles).//   | rals, but |  |  |  |  |  |  |

#### 1 Executive Summary

This Quality Assurance Assessment Report documents the details of an Area quality audit. The audit was performed by Software Quality from April 9, 2008, unquan April 15, 2009

An analysis of the ITD software and project processes, documentation, and work products was performed. This included review of documentation, overarching procedures, Sprint retrospectives and burn down charts, notes, meeting minutes, and interviews. The analysis was based on a tailored mini-appraisal or "gap analysis," as described in the CMMI SCAMPI B model.

The overall rating of this assessment indicated that the processes chosen to be audited were partially- to largely-implemented. However, several process areas were rated and not yet as they are ML 3 and are still in the implementation stage. Assessment results will be reported to the associated project leaders, team leaders, and selected management.

| Process Area   | Ranking         |
|--|-----------------|
| Measurement and Analysis   | 9 F I           |
| Process and Product Quality Assurance  | 7.5 LI          |
| Configuration Management   | NY              |
| Decision Analysis and Resolution   | 9 FI            |
| Project Planning   | 9 FI            |
| Project Monitoring and Control   | 8.4 LI          |
| Integrated Project Management  | 8.3 LI          |
| Risk Management  | 8.2 LI          |
| Requirements Management  | 6.4 LI          |
| Requirements Development   | ИУ              |
| Technical Solutions  | NY              |
| Product Integration  | 8.6 LI          |
| Verification and Validation  | 8.8 LI          |
| The same of the sa | OVER ALL 8.3 LI |

Assessor: Dana Roberson
Updated for
Factual Accuracy: Rebecca Dickens

Corrective actions and process improvements, based on the assessment results, will be documented and monitored. A follow-up on the corrective actions derived from the assessment results will take place within three months of acceptance of this report.



# **Tracking Quality Corrective Actions**

| 다<br>Process Area                        | #<br>artifacts<br>reviewed | Findings | #FI | # LI | #PI | # NY | # CAP  | # CA<br>completed | Date Completed  | Re-Evaluation<br>Date |
|--|----------------------------|----------|-----|------|-----|------|--|-------------------|---|-----------------------|
| Organizational Training                  |                            |          | 1   |      |     |      |  |                   | 4/21/2009 OT – Training: held on 11/12/08   |                       |
|  | 13                         | 2        |     |      |     |      | 1 Need to show where relevant<br>stakeholders have been involved<br>training in OT<br>2 Need to show upper management<br>and get responses |                   | for the full team. Emails show training announcement and follow-up with Frank. Surveys, however, have been lost due to change in evaluation database. (This applies to OPD and OPF as well, as they were all handled together.) | <mark>1</mark>        |
| Organizational Process<br>Definition     | 8                          | 1        |     | 1    |     |      | 1 Need to show upper management and get responses  |                   |   | Jun-09                |
| Organizational Process<br>Focus          | 8                          | 1        |     | 1    |     |      | 1 Need to show upper management and get responses  |                   |   | Jun-09                |
| Measurement and Analysis                 | s<br>5                     |          |     | 1    |     |      | 1 Need to show upper management and get responses  |                   |   | Jun-09                |
| Process and Product<br>Quality Assurance | 9                          | 2        |     | 1    |     |      | Need to show upper management<br>and get responses     Need to have objective evaluation of<br>all in house evaluations                    |                   |   | Jun-09                |
| Configuration Managemen                  | t                          |          |     |      |     |      | 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1  |                   |   |                       |

# Lessons Learned in Managing Risks Using CMMI-DEV and Agile

Transdyne Corporation
<a href="http://transdynecorp.com">http://transdynecorp.com</a>
CMMI Implementations in
Small & Medium Organizations



Management of complexity requires process discipline WHILE

Management of change requires rapid adaptability.



CMMI provides process discipline.

SCRUM (Agile) enhances adaptability and commitment.





# Lessons Learned in Managing Risks Using CMMI-DEV and Agile



Transdyne Corporation
<a href="http://transdynecorp.com">http://transdynecorp.com</a>
CMMI Implementations in
Small & Medium Organizations



Understand that all process improvement opportunities, as with all investments, have costs and risks. Introducing Agile, as with any new technology, needs the advocacy of all project stakeholders.

Participation of key staff members in planning practice implementation is needed to understand the continuity and costs and identify the key risks, such as customer culture.



The CMMI Risk Management Process Area practices are easily tailored and implemented via a suitable template for Agile based projects.

The Agile method emphasizes on-going requirements & design verification, daily SCRUMS with customer participation and team "espirit de corp". The Agile emphasis on these activities provides engineering practices that reduce risks in software engineering tasks.



#### Remember



CMMI-DEV is a process model, **NOT** a process description.

CMMI-DEV only defines "WHAT" to do, not "HOW" to do it.



Plan the process implementation so that you are taking advantage of the CMMI-DEV practices AND

Use the Agile Methodology for rapid turn around for low cost quality product.







## The End



You have just seen key benefits of using CMMI-DEV and Agile to reduce risks in software engineering from the "30,000 feet" level.



**Questions or Comments?** 

# **Examples of Mapped CMMI Specific Practices to Agile Life Cycle Steps**

#### Artifacts

Share Point Node Project Repository

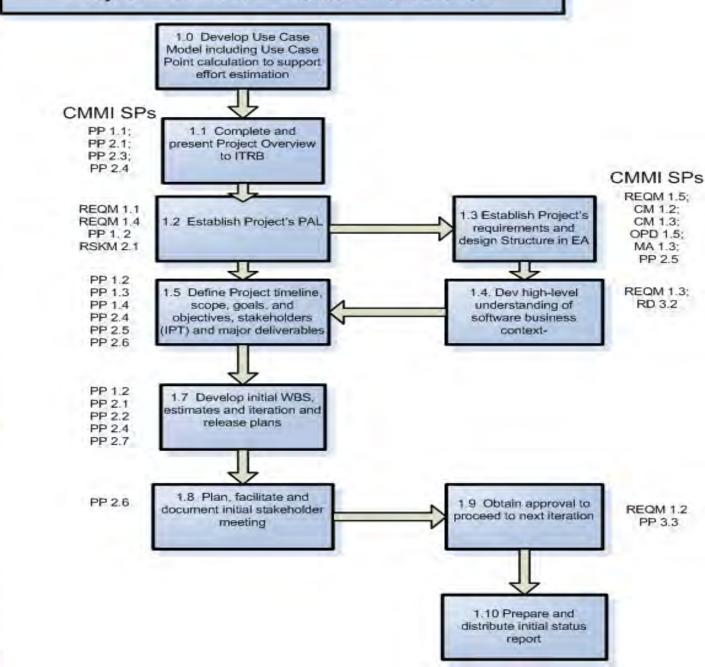
Enterprise Architect Package Requirements and Design tool

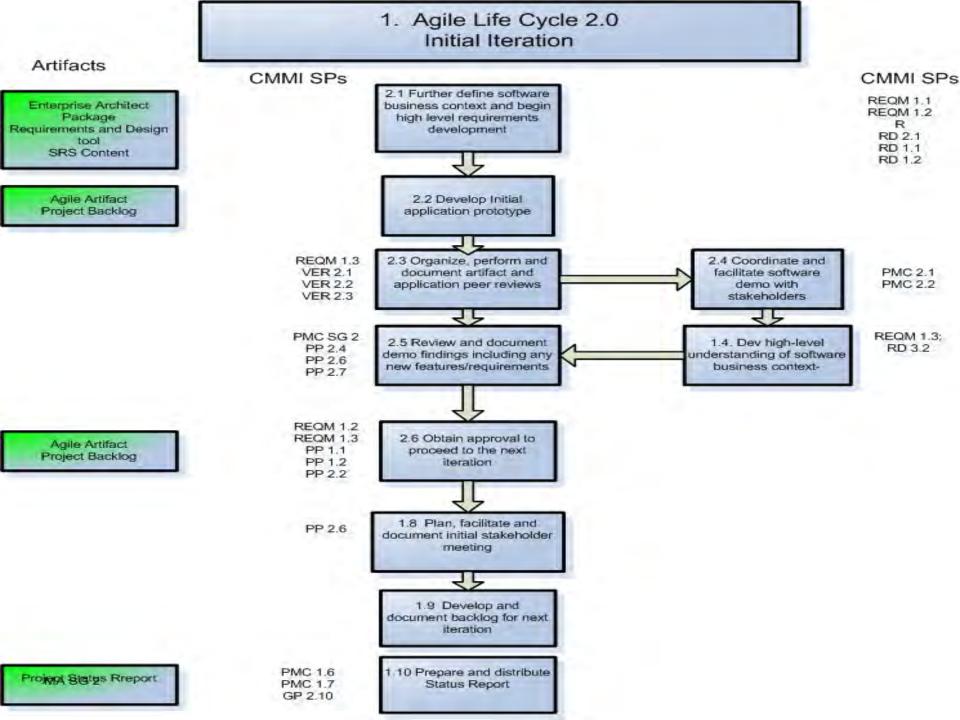
Agile Artifact Project Backlog including hours and estimates

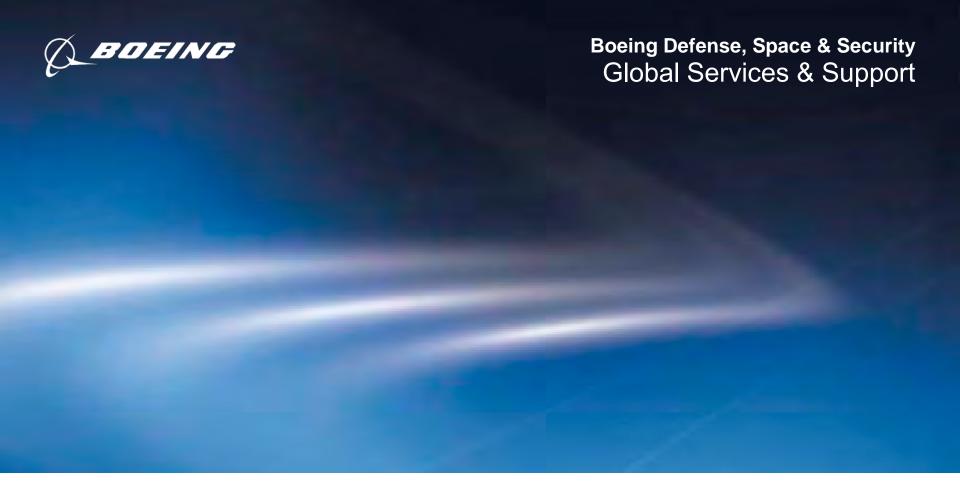
PP 2.2 PP 2.5 PP 3.1 PP 3.2 PP 3.3 REQM 1.2 MA SG 1

Project Status Rreport

# Agile Life Cycle Start Project Pre-Work – Prior to initial iteration







# Lean Development -Influencing the **Organization**

# **Presentation Organization**

Boeing Defense, Space and Security | Global Services & Support

- Introduction
  - Leverage Points
  - System View
- Description of the different type of leverage points
- How to apply to your project
- But first a story
  - Electronic company with good metrics
  - Root cause performed but not effective
  - Declining sales and quality
  - Program meetings focused on delivery and shipping metrics
    - Quality and production metrics always last ...if at all
  - End of one month, workers gathered the wheel stops from the parking lot!??

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Author, 11/22/2010, Filename.ppt | 2

# The Introduction – Leverage Points

Boeing Defense, Space and Security | Global Services & Support

- Leverage points are places within a complex system where a small shift can cause big changes
  - Best describe by Donnella H. Meadows 12 leverage points
  - Key to influencing the organization
- Leverage points are not a new idea imbedded in history, culture, and Legend
- Intuitively aware used wrong
  - Most organizations know about their leverage points
    - A given improvement team may not
  - Levers are often counterintuitive pushed when they should be pulled<sup>1</sup>
    - Strongest saving often come from redirecting the organizational force on their levers

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<sup>&</sup>lt;sup>1</sup> J.W Forrester, *World Dynamics* Portland Oreg.: Productivity Press 1971.

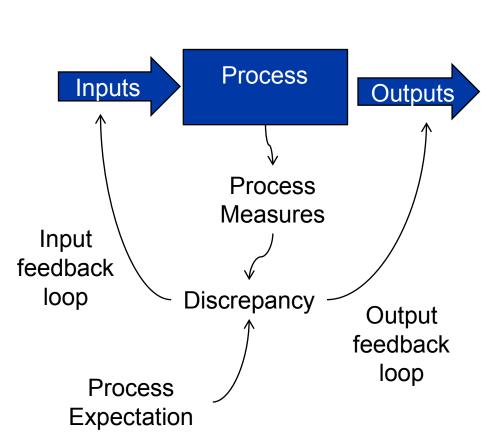
## Introduction – Leverage Points

Boeing Defense, Space and Security | Global Services & Support

- Traditional view of the forces acting for and against any improvement process
  - Budgetary
  - Organizational
  - Social
  - Strategic
- System thinking helps to rank and categorize these forces
  - Six Sigma "SIPOC" is a starting point

## The Introduction – A System View

Boeing Defense, Space and Security | Global Services & Support



- Process
- Inputs increase the available stock needed for the process
- Outputs decrease the available stock created by the process
- The Process Measures VS the Process expectation(s) the discrepancy
- Two negative feedback loops adjusts the input/output (WIP Control)
- The Process expectation and the feedback loops are outside the process

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### Introduction to the Levers

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- Some levers are stronger than others
  - The order of strength of the levers may vary
- Resistance to change higher for stronger levers
- Levers take various forms (lowest to highest)
  - Physical The "Hows"
  - Response The "Whats"
  - Transformational The "Whys"

## Physical – The lowest-level Levers (1 of 2)

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### Physical - lowest-level Levers

- 12. Numbers
  - -Think metrics, staffing levels, number of Cad terminal, etc
- 11. Buffers
  - -Think Overtime, work constraints, WIP, material stocks, etc
  - Has to be thought about in terms of the process needs

## Physical – The lowest-level Levers (2 of 2)

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### Physical - Lowest-level Levers

- 10. Process structure or network
  - Think hiring, office space, ability to add CAD terminals, machines, etc.
  - Machining centers, transfer lines, computer networks
- 9. Delays relative to the rate of changes
  - Think ability to respond: audit results, metrics, reaction to standard and special causes, etc
    - -How fast can you gear-up? wind-down?
    - -How fast
  - What happens if a very large order is received?
    - –How fast can your systems respond?

# Response – The Mid-level Levers Response (1 of 2)

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### Response - Mid-level Levers

- 8. Negative feedback loops
  - Think about how people respond to metrics, requests, issues, risks, etc.
  - Does it change based on who is involved?
  - Slows the process
- 7. Positive feedback loops
  - Think awards, encouragement, etc.
  - Often hard to quantify maybe intangible and invisible until the effect are felt
  - Speeds the process

## Response – The Mid-level Levers (2 of 2)

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### Response - Mid-level Levers

- 6. Information transparency
  - Who controls the information and who can see the information
  - Think about what change boards or other forums the data must go through
  - Who are the information gatekeeper in your organization?
  - This is why a given improvement team may not know the organizational leverage points

#### 5. Rules

- Think about the command media system
- Process Governance

# Transformational —The High-level Levers (1 of 2)

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### Transformational - The High-level Levers

- 4. The power of self-organization
  - Direct impact on Process Discipline
  - —Group theory: Tuchman's "forming storming, norming, performing"
  - Organizational Framework: Zachman layers are self-organizing
- 3. Process expectations

-Think about how the expectations impacts the feedback

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# Transformational —The High-level Levers (2 of 2)

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### Transformational - The High-level Levers

- 2. Process mindset or paradigm
  - Think about the underlying values of the organization, management, corporate culture, etc.
  - The lever is not easily move for a specific improvement process.
    - May determine what type of solutions are acceptable
  - –Six Sigma's "waves" approach

#### 1. Belief

- Strongly held belief
- Personality testing and surveys hints at how this is working in the organization

The organization promotes some while down playing others

## **Leverage Points – How to apply**

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### Look beyond just the facts

- When performing the analysis, understand what levers are influencing the project
  - E.g. Value stream maps often only describe the "Physical" and some "Response" levers – Add the other "Response" and "Transformational" levers
- When looking for solution(s), address multiple leverage points
  - E.g. A new metric is a "Physical" lever, changing the documented process is a "Response" lever, Shifting the goal of the process is a "transformational" lever.
  - Sometimes just adjusting the way a lever is applied is the best solution.

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## **Leverage Points – Conclusions**

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- The organization knows their leverage points
  - A given improvement team may not
  - Most organizations are using them wrong counterintuitive
- Promote multiple leverage solutions with the same goal for maximum impact
  - Ensure the solution is capture in the processes/systems for long term savings
  - Work towards transformational changes

## The rest of the Story

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- Shipping the wheel stops to various customer because they we short on a key metric: "Tons Shipped."
- Only metric the CEO was really concerned about
  - Prior job a CEO of a steel company
- Solution required changing the expectation of the processes
  - Only then does the quality and production methods show improvements

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### Reference

Boeing Defense, Space and Security | Global Services & Support

 Donella Meadows, Leverage Points: Places to Intervene in a System, 1999

http://www.sustainabilityinstitute.org/pubs/Leverage\_Points.pdf



# **Lean Development – Selecting the Right Tools** for Maximum Success

## **Presentation Organization**

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- Introduction to tools and the usage
- Introduction to Enterprise Frameworks
- Framework Why should I care?
- Description of aFramework
- Description of the different layers of the framework and their role in improvement efforts
- How to apply to your project

## Introduction to tools and the usage - CMMI

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See how I do my tasks by writing them – defined processes



Am I following my defined processes?



• Am I measuring my defined processes?



 I can identify improvements because they're defined, controlled and measured

### Introduction to Tools - Tactical solutions

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- Process improvement methods, models and techniques are like tools.
  - Pick the tool for the job
  - If you only have a hammer in your tool box, every problem will look like a nail!
  - Tools are used together to insure overall improvement



| Tool Box | Six<br>Sigma     | Lean            | Theory of constraints |
|----------|------------------|-----------------|-----------------------|
| Theory   | Reduce variation | Remove waste    | Manage constraints    |
| Focus    | Problem focused  | Flow<br>focused | Systems constraints   |

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# Introduction to Tools – Six Sigma, Lean, TOC Comparison

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#### Complexity of problem

- High Theory of Constraints
- Medium Lean
- Low Six Sigma

#### Organizational culture

- Authority driven Theory of constraints
- Authority approved/team-shared work Six Sigma
- Teamwork directed Lean

#### Driving factors

- Logic Theory of Constraints
- Data Six Sigma
- Flow Lean

#### ROI visibility

- High Six Sigma
- Medium Theory of Constraints
- Low Lean

### Introduction – Frameworks

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- The biggest Issue with improvement tools is not learning the tools but proper application.
  - Improvement methods widely defused
  - Shotgun approach ineffective
  - Organizations have hard time focusing efforts
  - Low hanging fruit picked
    - Need to make improvements higher in the organization
    - Need to improve the organization's health
- Frameworks are key to focusing the organizational efforts

## Introduction - Frameworks

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- Most people have some understanding of the organizational framework.
  - Organizational chart
    - I know my boss/program/division/company/etc
  - Learned in High School English the 5 W and H.
    - What, Where, Who, When, Why and How
  - Understand the organization has different functions
    - Executive leaders, IT, Engineering, Quality, Operations, etc
    - May or may not understand their respective relationship
- A Framework is simply helps to integration of things and their relationships

## Framework – Why should I care?

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- The layers of the framework are self-organizing
  - Will always work to be integrated
  - Will not inherently be efficient or effective
- Resolving conflicts in the frameworks are key to process improvement
  - There will always be conflict in the framework
  - Unresolved conflict will increase uncertainty resulting in increased cost and schedule while decreasing quality
  - Conflicts often are resolved in ways that create constraints as the organization changes

## Framework – Why should I care?

Boeing Defense, Space and Security | Global Services & Support

- The layers of the framework are self-organizing
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### Introduction – Frameworks

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# Classification system is by John A. Zachman

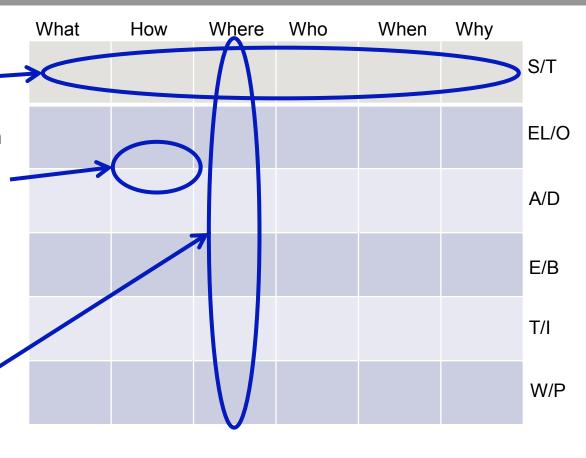
- -6X6 Matrix
- -5 W and H across the top
- –6 different "transformational" layers
- –Available from <a href="http://www.zachmaninternational.com/">http://www.zachmaninternational.com/</a>

**DODAF 2.0** 

### Introduction – Framework

Boeing Defense, Space and Security | Global Services & Support

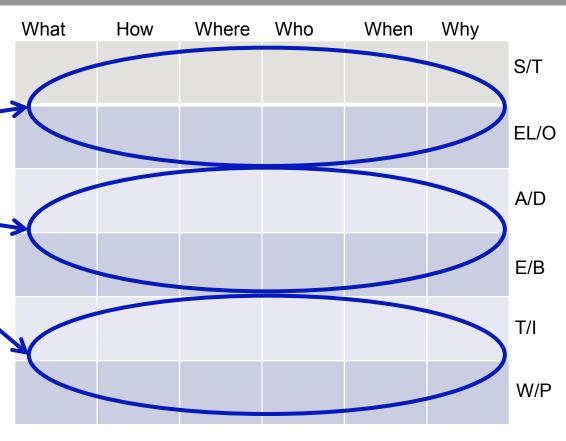
- The easiest savings comes from resolving conflicts within a layer.
- Resolving conflicts between two layer results in 10X the savings
- The higher the conflict is in the architecture the greater the saving and the resistance
- The integrating a column multiples the savings as the conflicts between all the layer of that column are resolved.



## Introduction –Framework

Boeing Defense, Space and Security | Global Services & Support

- Primary activity of the layer change and thus need to use different tools
- Top two layer are addressing the "Whys" of the business
- The middle two layer are addressing the "Whats" of the business
- The bottom two layer are addressing the "Hows" of the business
- Tools need to match the primary task of the layer



# Frameworks and Tool Selection – How to apply

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- Attempt to fill in the framework
  - Difficulties in completing highlights improvement opportunities
- Empty blocks or controversial block answers highlight conflicts
  - Upper layer use Theory of Constraint
  - -Middle level use Design for Six Sigma
  - –Lower levels use Lean/six sigma

# Frameworks and Tool Selection – How to apply

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## •Multiple blocks within a layer

- For mid or lower level layer Determine if issue is flow or data or conflict
  - -Flow Lean
  - –Data Six sigma
  - –Conflict Theory of Constraints
- For high level layer start with Theory of Constraints

# Frameworks and Tool Selection – How to apply

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- Vertically-aligned blocks are conflicts and transformations difficulties
  - Theory of Constraints preferred tool
  - Focus effort to resolve similar business questions
  - Caution not to jump layers
  - For high level layer start with Theory of Constraints

### **Conclusions**

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- There are multiple tool boxes with a wide range of tools
  - This presentation only touched on Three
- Using a framework helps to find improvement opportunities
- Holes in the framework highlight the organizational conflicts

### **Conclusions**

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- Resolving conflicts in the architecture results in saving.
  - Higher in the framework the greater the saving
  - Conflicts between the layer result in larger savings than resolving the conflict within the layer
- Knowing the conflict type and location helps determine the correct tool set.

#### Boeing Defense, Space and Security | Global Services & Support



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### Reference

Boeing Defense, Space and Security | Global Services & Support

Zachman information <a href="http://www.zachmaninternational.com/">http://www.zachmaninternational.com/</a>

DODAF 2.0 information

# CMMI Implementation Strategies for Success

Stephen M. Austin

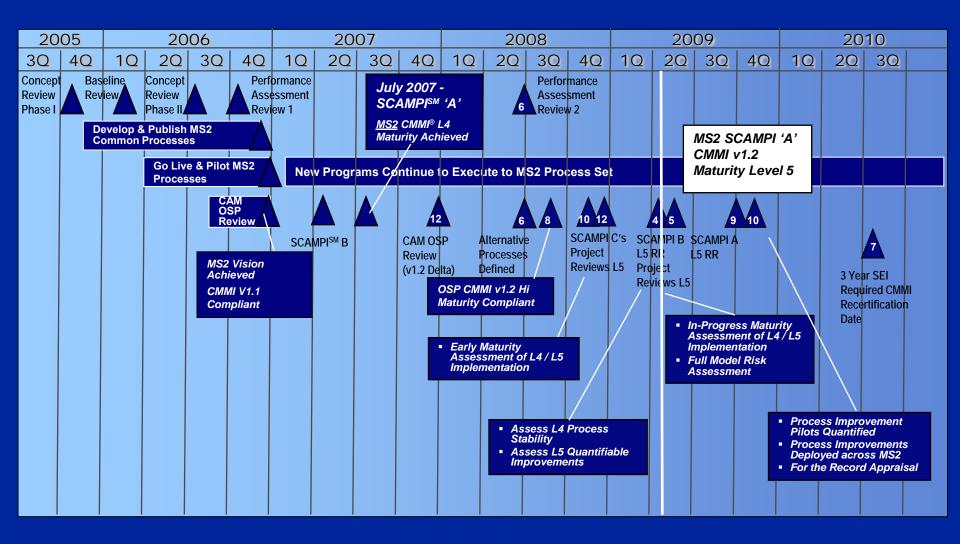




Geographically Dispersed - 13,000 Employees in 6 Primary Locations

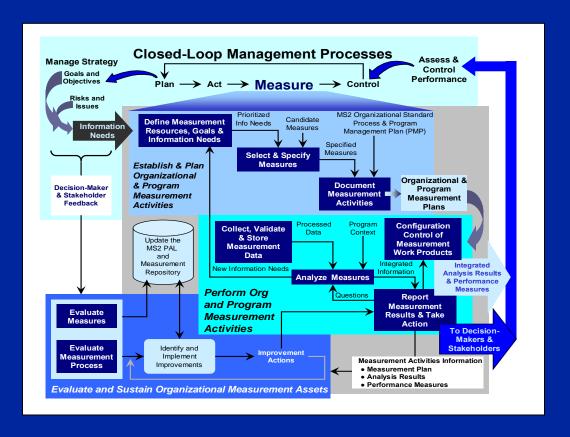
### MS2 Path to CMMI Level 5

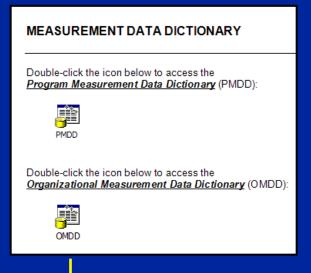




# MS2 Measurement Program Core Components









Plans





Common Measures



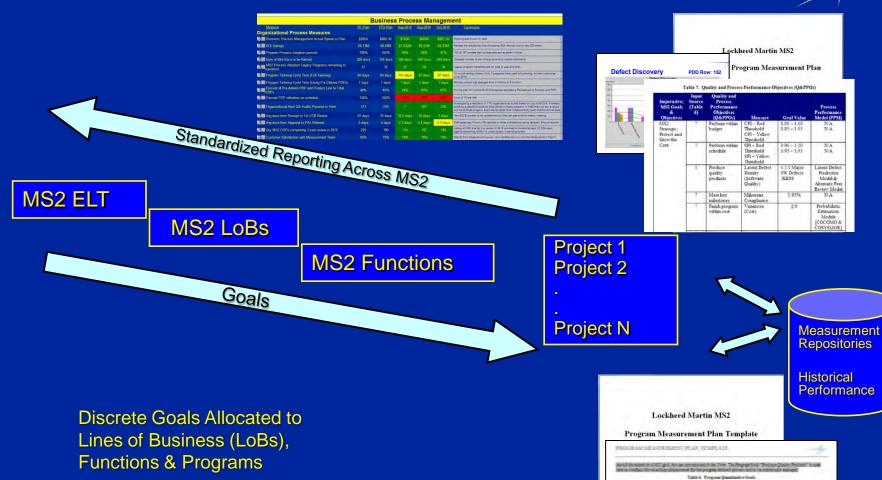
**Training** 

Tools & Infrastructure

Business & Program Decision Making

## **Goal Flowdown Drives Information Needs Across the Enterprise**





| Table 6. Program Quantitative Costs                         |  |                             |                |                   |
|---|--|-----------------------------|----------------|-------------------|
| MELGON  | Fragram Goal                           | Messes                      | Gest.<br>Value | Profest<br>+ Mode |
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|   | Coopine critical<br>complement or fine | Doors had betomine          | 285            | . %               |

## Final Thoughts...



- Once you make the Decision to Pursue an Appraisal Run it Like a Program
- Centralize Activities that Need to be Common
  - Measurement Infrastructure Supports both the Organization and Programs
  - Robust Organizational Measurement Repository
  - Establish set of PPBs and PPMs to meet Business Needs
  - PPMs satisfy intent of "Healthy Characteristics"
  - Continue to refine / evolve PPBs
- Leverage existing efforts as much as possible:
  - Programs leverage Black Belts for statistical thinking
  - Existing Operating Excellence efforts synergistic w/ Level 5



# Improve Patient Care. Maximize Business Results.

# Implementing CMMI in a Virtual Development Organization

Rick Bennett, Director of Development November 16, 2010



## **MedPlus**

- Customer facing software division of Quest Diagnostics Incorporated.
  - > Hospital / IDN
  - > HIE / Government
  - > Physician Office
- Quest Diagnostics is the world's largest chain of clinical diagnostic laboratories.
  - > Grown by acquisition
  - > Disparate systems and data centers
  - > Greater than a half million specimens per day



## Care 360 Lab Orders and Results

- Originally developed in 2000
- >60 % percent of Quest Diagnostics orders pass through Care 360 LOR
  - > 300,000 per day
- 990,000 registered users
- 44,000 simultaneous peak users per day
- **42,000,000,000** unique results
- 19 TB of data
- Six Sigma up time
- Every specimen represents a human life
- Awarded United States Patent #7,567,913



## **Diagnostics Services Group**

- Extremely virtual team
- 45 Developers, requirements analysts, QA analysts, support analysts, PM's and resource managers in 16 locations
- Modified waterfall SDLC
- 4 releases per year
- Six Sigma trained
  - > 2 Black Belts, >10 Green Belts
- Daily all hands calls
- Heavy use of instant messaging and smaller conference calls.
- High employee satisfaction
- Function points analysis showing consistently high productivity



## LOR Team Geographically





## Why CMMI?

- Low CMMI penetration in HealthCare IT
  - > Not a necessity for sales in our market space
- Create a more predictable process
  - > Make post release week feel like any other week
- Improve quality where possible
- Align to customer goals
- Maintain autonomy
  - > Team structure and geography unique to our organization



## How did we get to Level 5?

- Management involvement
  - > Training
- Leveraged Six Sigma training and culture
  - > Access to Master Black Belts
- Stretch to achieve a level then refine those processes while pushing to achieve the next level.
  - > SEPG
  - > Obtain practitioner feedback and refine
  - > Perfect is the enemy of good for initial processes
- Keep focus on the reasons for process improvement
- Tap into innovative spirit
  - > Particularly at the High Maturity levels

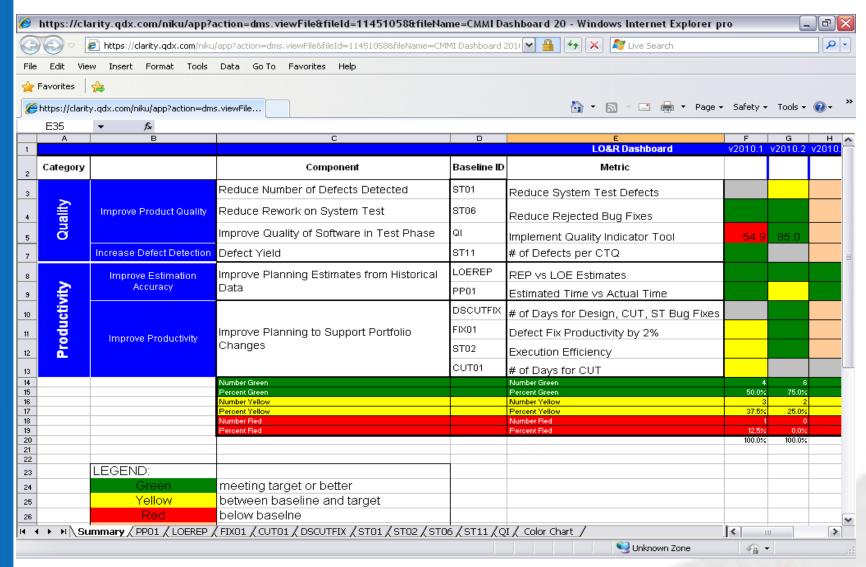


### Results

- Assessed at CMMI Level 2 August 2005
- Assessed at CMMI Level 3 July 2008
- Assessed at CMMI Level 5 June 2010
- Acknowledged process leaders in our organization and company
- Increased visibility into status of processes during development phases and increased understanding of process capability yielding increased confidence in final product
- Increased visibility into linkage between micro activity and fulfillment of customer goals



## **QPPO Dashboard.**





## **Questions?**

Rick.J.Bennett@questdiagnostics.com



# **CMMI® Implementation Strategies for Success Panel**

16 Nov 2010

## Discussion Topics

Strategies for Success

 How to implement good, effective measures to determine what CMMI specifically does for your organization

Benefits of CMMI

## Steps to Success Using CMMI

#### **Understand Your Organizational Objectives**

- Just to get organized?
- Get an External Rating?
- Reduce Costs?

- Improve Quality?
- Delight Customers?

#### Ensure top-down buy for Objectives & Strategies to achieve

"CMMI" objectives should not be standalone

#### Leverage Industry Experience

- Reasonable expectations for velocity of change
- Benchmark cost, schedule, tactical plans

#### **Establish Measures for Success**

- Meaningful to the organization
- Consider items that measure achievement over time
- Get specific

#### Measures of CMMI Effectiveness

#### For Organizations just starting out...

- % of target employee group that knows where to find processes and how to suggest changes (survey)
- Count of "escapes" attributable to poor or unknown process instruction
- Specific process area metrics

#### For More Mature Organizations ...

- Measures of execution improvement (overall or targeted improvement initiatives)
  - Cycle time
  - Quality
  - Technical performance
  - customer satisfaction
- Extent of process improvement involvement from the organization (# suggested, % implemented, analysis of origin)

## Benefits of CMMI

#### Provides a neutral framework for best practices

- No need to invent/maintain your own standard
- Common language across diverse business & customer base
- Accommodates organizational unique criteria

#### Allows alignment of diverse improvement methods

- Focuses all efforts to support organizational objectives
- Guides integration and prioritization of improvements

#### Biggest benefit is organizational process areas

- Infrastructure basics enable re-organization agility
- Again links process management & improvement to organizational objectives







## CMMI 10th Annual Technology Conference-

**CMMI Implementation Strategies for Success** 



**Guiding Principles:** 

The reason to implement CMMI is to improve business performance The only successful CMMI implementation addresses business needs The only successful measures connect to business performance needs



## **Goals of CMMI Implementation**

- Using the CMMI should improve quality, cost and schedule (productivity) performance of your organization
- A few published improvements in Defense Industries
  - On-time deliverable increase from 95% to 99.9%
  - 6.35 times less defect discovery and repair hours during system testing
  - Schedule Performance Index increase from .78 to .93 over three years
  - Cost Performance Index increase from .88 to .96 over two years
- See "Benefits of CMMI Within the Defense Industry"
  - Published by Software Engineering Institute, Carnegie Mellon University, Pittsburgh, PA 15213, May 2010 © 2010 Carnegie Mellon University
  - http://www.sei.cmu.edu/library/abstracts/presentations/CMMI-Benefits-to-Defense-Industry.cfm

The only reason to implement CMMI is to improve performance



## Steps in Implementation

- Determine where you are as compared to the model
  - "If you do not know where you are, a map won't help"- Watts Humphrey
  - Most companies have some practices that are consistent with the model
  - Find the right behaviors in your business and leverage them
- Document your good processes that are in place but are not recorded
  - Use pictures, automated tools, text, cartoons, whatever works
- Implement processes to fill gaps that address business needs !!!
  - CMMI practices are not processes
  - Prioritized
  - "Natural" for the environment
  - Integrated into how you do business targeted your value stream
  - You are ready for- maturity means experiencing and then learning
- Monitor penetration and institutionalization
  - Growth in and the consistency of organizational use will support increasing organizational capability

The only successful implementation addresses business needs



### **CMMI Implementation Success**

- Effective Use of CMMI applies processes that enhance the business based upon the model\*
  - CMMI is a model for process improvement, not a standard and not a process. Adapt to business environment and available resources with a focus on performance and business results
  - Good processes, implemented effectively in an environment of continuous process improvement, increase the likelihood of achieving success
  - CMMI can help resultant processes align with achieving business objectives (Organizations making achievement of CMMI maturity levels their primary business objective may not achieve benefits). Focusing on areas where improvement is needed to achieve business objectives improves acceptance.
  - Advancements in CMMI maturity levels should be based on a business case for improved performance
  - CMMI maturity level ratings are useful for gauging progress in achieving organizational process improvement, but
    ratings are not alone a predictor of expected project performance. If a project or organization fails to consistently utilize
    its capability, problems will occur.
  - Do not use CMMI as a supplier selection tool by specifying CMMI maturity levels
  - Employ appraisal methods of various types and levels of formality to identify weaknesses for prioritizing improvements
    - \*Excerpted from "The Economics of CMMI" http://www.sei.cmu.edu/library/abstracts/whitepapers/economics-of-cmmi.cfm
- Do not allow outside consultants to "change the way you do business"
- Do not simply copy another's process, it might not work for you

The only successful implementation address business needs



#### Measures connected to Business Needs

#### Using CMMI improves the business

- Use typical business measures over the long term to determine effectiveness
  - Performance (CPI, SPI)
  - Profitability (Operating Costs versus sales)
  - Competiveness (Win Rate, Sales)
  - Timeliness (Time to Market)
  - Quality
  - Other measures used successfully: dollarized risk of non-containing requirements, first pass yield predictions, predicted average unit cost [all in design phase]
- These big measures derive "smaller" measures
  - Eg., productivity and EVMS (Individual work package budget efficiency)
  - Productivity and profitability measures create focus on rework and defect containment in phase
  - Leads to measuring things that can be measured in a smaller time spans
- Keep the connection from "small" measures to "big" measure visible





#### **Measures connected to Business Needs**

- Get all your business leaders to champion these measures and the connections
  - Easier said then done?
- Keep measures balanced
  - Efficiency, Quality, Cycle Time, Timeliness
  - Measure all aspects so that one aspect does not override the others
- Increase ROI for CMMI from improving performance (shown in measures) while decreasing the cost of implementation
- Some measures we have used effectively:
  - CPI/SPI
  - Requirements Volatility
  - Defect Containment/Density
  - Rework (Drawing re-release)
  - ROI

- Drawing Release
- Design Margin Index
- Size and Productivity
- Staffing
- On-time Delivery

The only successful measures address business needs



## **CMMI 10th Annual Technology Conference-**

#### **CMMI Implementation Strategies for Success**

Questions?
Nancy Fleischer

nlfleischer@raytheon.com

310-400-4490



"The most important business indicators are our performance to our business goals, and in most cases, the activities that we mapped to CMMI are the same activities that are strong contributors to our business performance and whether we are meeting those business goals."





## ASA(ALT) System of Systems Engineering Processes

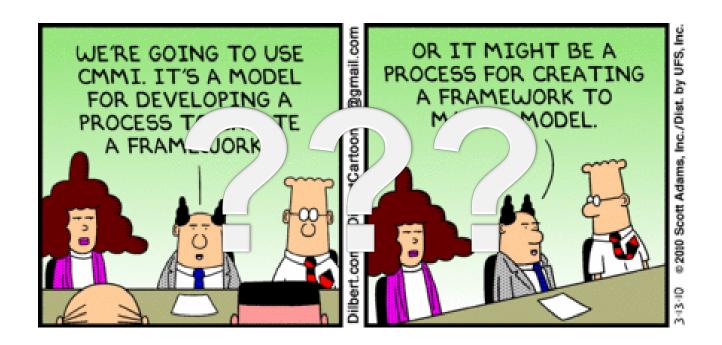
## CMMI Technology Conference 16 Nov 2010 Implementation Strategy & the CMMI®

Mr. Terry Edwards
Director, ASA(ALT) SoSE
(703) 614-4540
terry.edwards@us.army.mil





## The Army's View of CMMI...



CMMI has arrived, and we have embraced it !!!



## **Strategic Environment**

ASA (AL&T)



#### Operational

- > Persistent conflict,
- Hybrid threats requiring hybrid solutions
- Advanced/improvised technologies targeted against the warfighter

#### Budget

- > Pressure to cut defense & other spending
- ➤ Topline base budget expected to have modest, but steady growth
- > "Do more without more"
- > Reduce lifecycle-costs



#### Army Modernization

- >BCT-centric
- ➤ Buy fewer, more often
- ➤ Incremental fielding of capability thru ARFORGEN

#### Acquisition Reform

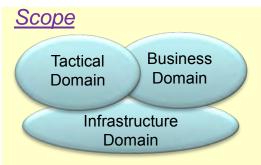
- Increased competition throughout acquisition process
- ➤ Reduced tolerance for cost/schedule risk
- ➤ Revised Milestone certification reqs
- > Foster innovation





#### System of Systems Engineering (SoSE) – Environment

ASA (AL&T)



#### Build the Bench

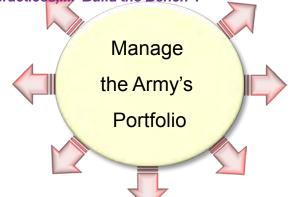
- Organize the Army Engineering Community
- Establish Technical Authority and engineering expertise/capability
- Pursue accreditation and certifications of organic workforce & organizations

#### Create Data Transparency

- Establish CM and an authoritative repository for products
- Establish a collaboration environment
- Establish a common operating environment for engineering Products

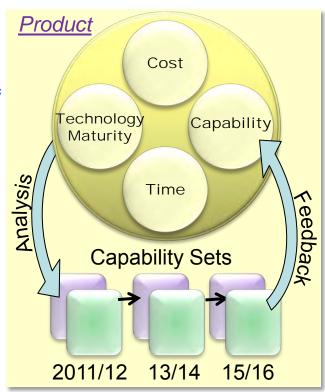
MISSION The Mission of ASA(ALT) SOSE:

Provide the Army's leadership and materiel developers with the necessary engineering/architectural products to manage and shape the Army's materiel portfolio, to ensure a System Engineering discipline across the Materiel developer community throughout the acquisition life cycle and grow the System Engineering capability within the Army – through education, engineering policy, guidelines and adoption of best industry practices, "Build the Bench".



## Enable the Process Establish the engineering process to

- deliver synchronized capability
- Establish the analytical structure with models & simulations
- Establish the engineering compliance structure/process for acquisition execution excellence
- Deliver engineering support to HQ staff and acquisition community



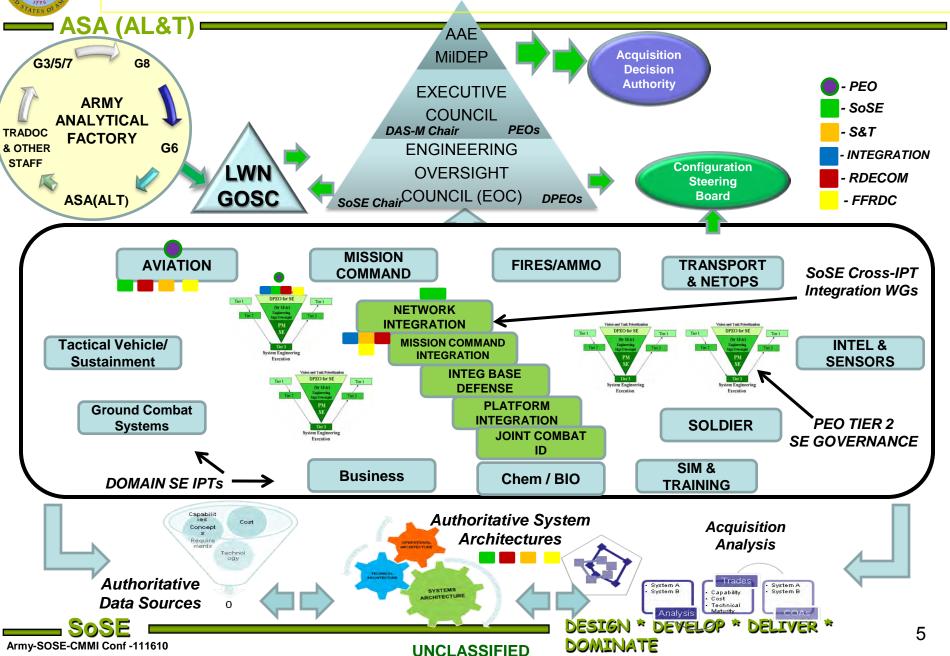
#### Manage the Portfolio

- Support the prioritization of capabilities within the portfolio
- Set the baseline architecture roadmap over time
- Support the resourcing process
- Synchronize and align the S&T, systems integration, test, and certification activities

Ver. 2.7

**UNCLASSIFIED** 

## **Organizing the SoS Space**





#### The 'Network'

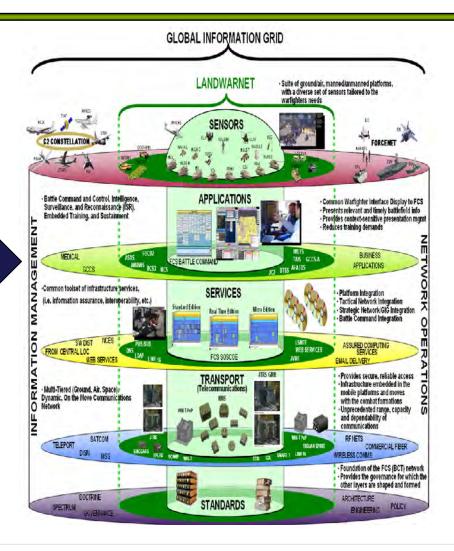
Typical 'Network' Layers

- Sensors
- Applications
- Services
- Transport
- Standards

Added

- Force Structure
- NETOPS

Applications & Services

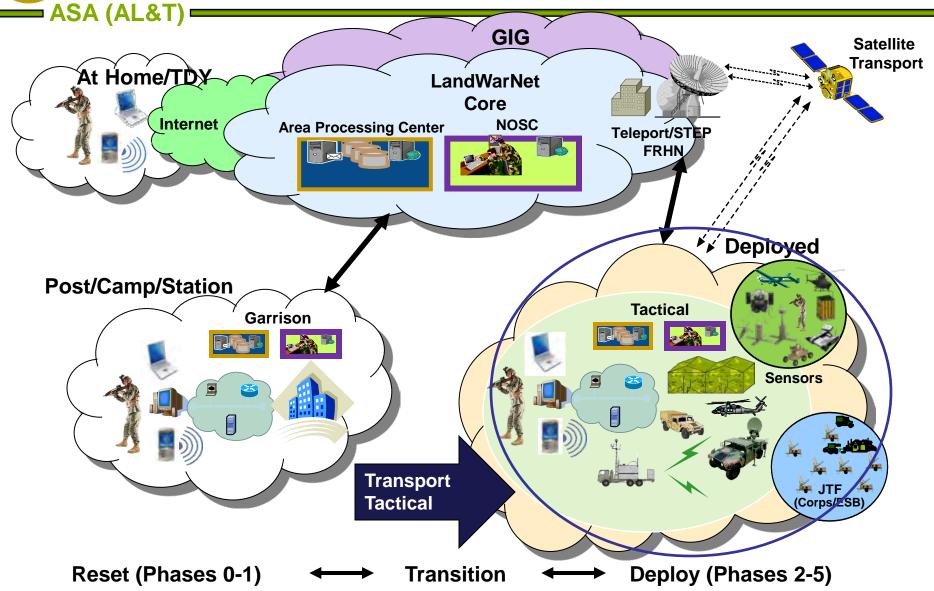


"The Network is the singularly most important program to the Army"

-- GEN George W. Casey, Jr. 23 July 2010



## **Army Network – Enterprise View**





## **COE Architecture Guidance**

ASA (AL&T)



DEPARTMENT OF THE ARMY WASHINGTON DC 20210

OCT 2 0 2010

SAIS-AEA

#### MEMORANDUM FOR SEE DISTRIBUTION

SUBJECT: Common Operating Environment Architecture Guidance

- References:
- Memorandum, Vice Chief of Staff of the Army (VCSA), subject: Achieving Army Network and Battle Command Modernization Objectives, dated 28 December 2009
- Document, CIO/G-6, titled: Common Operating Environment Architecture, (Appendix C to Guidance for 'End State' Army Enterprise Network Architecture), dated 1 October 2010
- 2. The CIO/G-6, in close coordination with ASA(ALT) Systems of Systems Engineering (SOSE), has developed the Common Operating Environment (COE) Architecture concept, framework and standards for the Army Enterprise Network. In addition, in order to inform Program Objective Memorandum 13-17 investment decisions, ASA(ALT) will publish a complementary Implementation Plan that describes the steps and schedule for bringing Army systems into compliance with the COE Architecture guidance. Henceforth, compliance with the COE Architecture and Implementation Plan will be mandatory for all programs under the purview of the Army Acquisition Executive.
- 3. The CIO/G-6 and ASA(ALT) are committed to enabling the Army to produce high-quality applications rapidly while reducing the complexities embedded in the design, development, testing and deployment cycle. The COE Architecture and Implementation Plan will provide direction to our industry partners regarding our framework standards. Both documents are considered to be living instruments and will continue to evolve in a coordinated manner in order to keep up with the rapid changes in technology.
- Our points of contact for this memorandum are: COL Anthony Howard, Sr., (703) 604-2068 or anthony.howardsr@us.army.mil; and Mr. Phillip Minor, (703) 604-7133 or phillip.minor@us.army.mil.

JEFFREY A. SORENSON Jeutenant General, GS Chief Information Officer/G-6

Malcolm R. O'Neill
Assistant Secretary of the Army
(Acquisition, Logistics and Technology)

- CIO/G-6 in close coordination with ASA(ALT) Systems of Systems Engineering (SOSE) has developed COE Architecture Guidance
- COE Architecture Guidance:
  - Defines the COE and Computing Environments
  - Describes the CEs architecture and services
  - Specifies COE principles and technical architecture standards
  - Details a maturity model for cost-benefit analysis trades and to evaluate programs' alignments with COE
- ASA(ALT) will develop COE Implementation Plan:
  - Inform Program Objective Memorandum (POM) 13-17 investment decisions
  - Identify the implementation strategy, time lines, effective dates and key milestones for

"Establishing 'left and right limits' . . . Chiarolli Touts Common Operating En

Chiarelli Touts Common Operating Environment Architecture At AUSA

- By Tony Bertuca, Inside the Army, October 29, 2010





## Army needs a Software "Eco-System"

ASA (AL&T)

**Software Ecosystem** defined as a set of businesses functioning as a unit and interacting with a shared market for software and services, together with relationships among them. These relationships are frequently underpinned by a common technological platform and operate through the exchange of information, resources, and artifacts — David G. Messerschmitt and Clemens Szyperski (2003). Software Ecosystem: Understanding an Indispensable Technology and Industry. Cambridge, MA, USA: MIT Press.

## An Army Eco-System would need to provide:

- Improved agility
- Reduced life cycle costs
- Adaptability
- Means to address cyber threats





## Realizing the Army Software Eco-System

ASA (AL&T)

Eco-System Realization: A Common Operating Environment (COE)

#### **Common Operating Environment:**

Automation services that support the development of the *common reusable software modules* that enable interoperability across multiple combat support applications. This includes segmentation of common software modules from existing applications, integration of commercial products, development of a common architecture, and development of common tools for application developers.

Dictionary of Military and Associated Terms. US Department of Defense 2005.



# **But, an Army COE Must**

ASA (AL&T)

Operate across families of computing environments (CE):

- Data Center / Cloud
- Command Post
- Real-Time, Safety-Critical, & Embedded
- Mounted
- Mobile/Handheld
- Sensors

# Enterprise Common Operating Environment Client Mobile Sensors

#### AND

- Improve agility: In development, acquisition & operations
- Reduce life cycle cost: In both new and legacy applications
- Be adaptable: To changing standards across all Army systems
- Address cyber needs: Keep pace with ever changing threats



# Computing Environment Example

(Mobile Handheld)

ASA (AL&T)







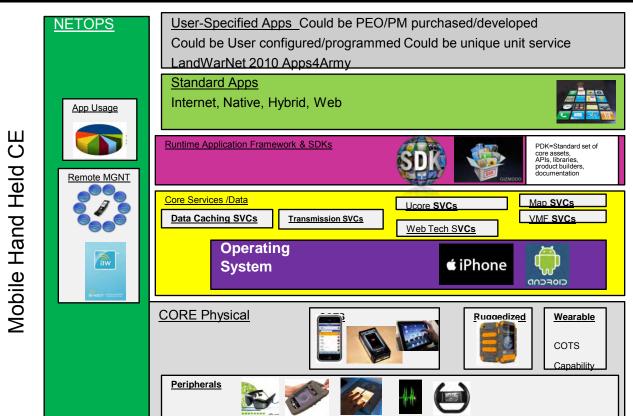




















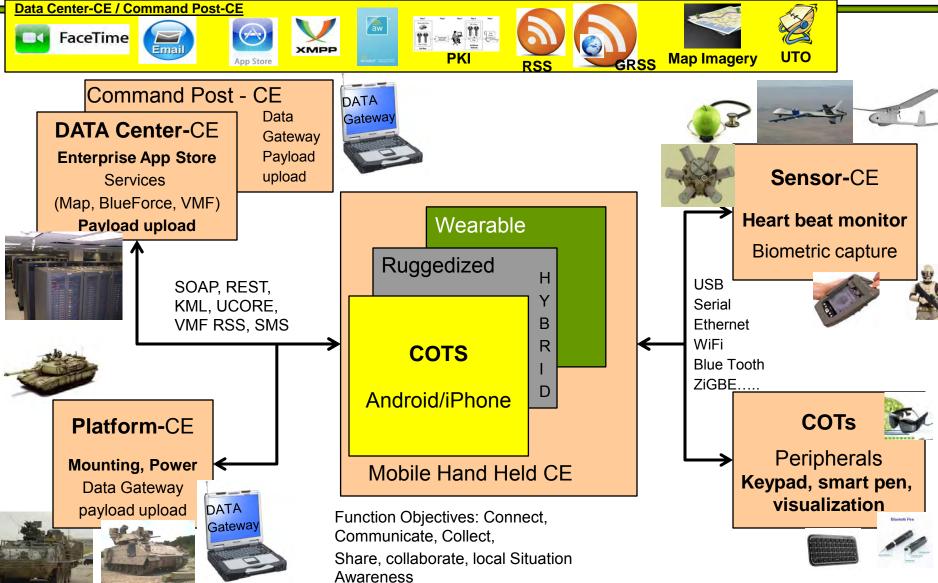






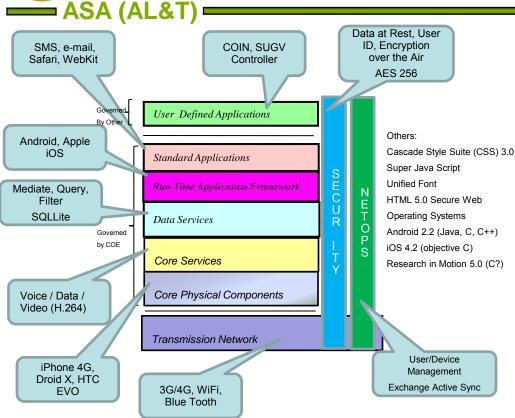


# **CE Relationships and Boundaries**





# **Adaptability Game Changer**



# Adaptability Game Changer Attributes

- Provides ability to access enterprise application store
- Provides ability to rapidly deliver mission specific/soldier centric capabilities
- Provides the ability to let the soldier tailor different applications, widget to meet their function, task, condition, standard for mission success
- Enables short release cycles of functional capability (deployed as apps)
- Enables flexible delivery of capability
- Enables user or 3<sup>rd</sup> party
   contributions of capability (through
   the Enterprise App Store)



# Will a COE work?

ASA (AL&T)

It has to, because today...

- Software has value only in the context of the system it was developed to support (and the contractor who developed it)
- Software Integration & Interoperability have become intractable
- It takes too long to capitalize on commercially available solutions/innovations

#### It can if...

- The implementation starts with a minimum set of standards
- Standards & common services are planned to evolve continuously (with appropriate resources) aligned with Army goals & objectives
- Compliance is incentivized (and enforced)
- The processes for managing the COE are disciplined, transparent and support application developers

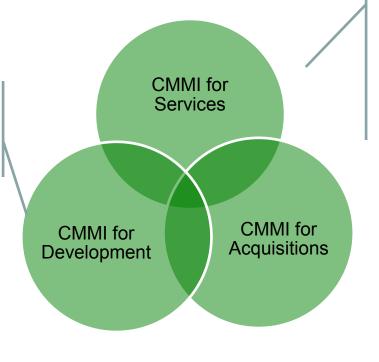


# **How CMMI Can Help**

CMMI provides a model that can support the disciplined enterprise-level implementation of the processes needs to develop, evolve, and deliver the common services required by

the COE:

Used to implement/evolve common services



Used for managing interfaces/solicitat ion of needs from application developers

Used to buy commercial/indus try supplied services



# **CMMI – The Value Proposition (1)**

ASA (AL&T) =

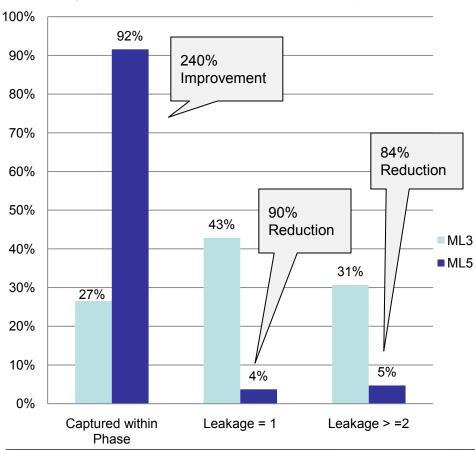
Goal – Reduce Armament SEC software life cycle costs by identifying and fixing defects closer to phase of origin (requirements, design, code, integration, test)

- Established Armament SEC baselines and models using industry-standard Defect Containment Matrix (DCM) methodology
  - Tracked defect "phase leakage" (finding defects in phases after the originating phase)

|        | Life Cycle Phase Discovered |      |     |     |     |     |     |      |            |
|--------|-----------------------------|------|-----|-----|-----|-----|-----|------|------------|
|        |                             |      | L   | R   | D   | С   | - 1 | Т    | In the red |
|        | Legacy                      | 10%  | 29% | 7%  | 4%  | 29% | 17% | 14%  | 64%        |
| ated   | Requirements                | 60%  |     | 75% | 5%  | 16% | 2%  | 2%   | 20%        |
|        | Design                      | 4%   |     |     | 67% | 16% | 0%  | 17%  | 17%        |
| Origin | Code and Unit Test          | 22%  |     |     |     | 89% | 3%  | 8%   | 8%         |
| ō      | Integration Test            | 2%   |     |     |     |     | 66% | 34%  |            |
|        | Test                        | 2%   |     |     |     |     |     | 100% |            |
|        |                             | 100% | 3%  | 46% | 6%  | 32% | 5%  | 8%   |            |
|        |                             |      |     |     |     |     |     |      |            |

- Maturity Level 5 projects' focus:
  - Optimize within-phase verification processes (e.g., Peer Review, Unit Testing, etc)
  - Leverage reuse of mature code
  - Increase automation of testing

# Defects Phase Containment / Leakage (High Severity Defects - Priority 1, 2 & 3)



#### Cost avoidance realized:

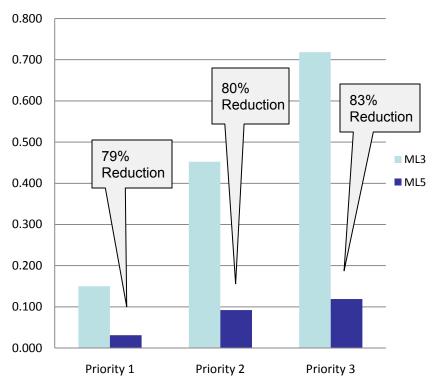
- Less rework late in life cycle when it is most expensive to repair
- Resulting in reduced schedule risk



# CMMI – The Value Proposition (2)

ASA (AL&T) =

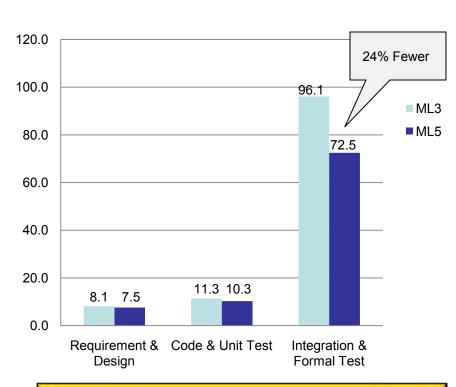
Defect Density by Priority (PCR) (High Severity Defects Only) (Ave Project – 219 KSLOC)



**Highest severity** defects leaked are decreased by at least 79%:

- More rigorous peer reviews focusing on systemic issues
- Broadened participation and tailored role-based review criteria

Average Hours per Defect per Phase to Repair (High Severity Defects)



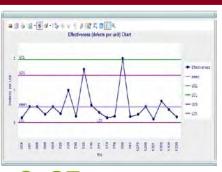
Defects discovered in ML5 projects cost less to repair in all phases on average – in particular, Integration & Test phases achieved a 24% reduction of hours expended

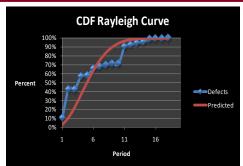


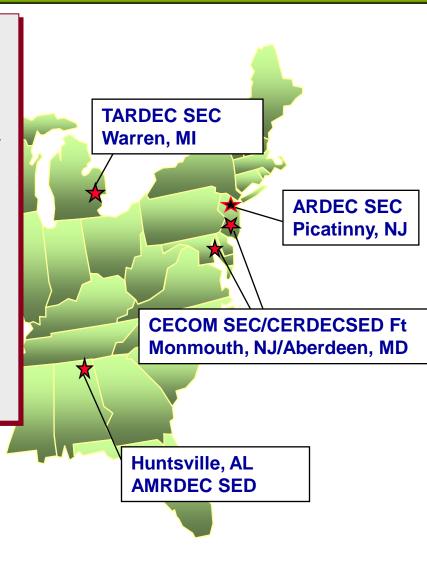
# **Build the Credentials of the Organization**

ASA (AL&T)

- Pursue improvement opportunities across the Army acquisition/engineering community
- Share best practices among diverse Army acquisition/engineering organizations
- Leverage high performing acquisition/engineering organizations
- Army Systems Engineering Forum
- Army Strategic Software Improvement Program









# **BUT – This is Uncharted Territory**

ASA (AL&T) =

- There is scant data about actual use of the CMMI constellations in common operating environments, which suggests
  - It hasn't been done before
  - If it has been done, the results are being held proprietary

We'd love to hear your thoughts & experiences...



# **CMMI® Version 1.3 and Beyond**

November 2010

Mike Phillips
Software Engineering Institute
Carnegie Mellon University

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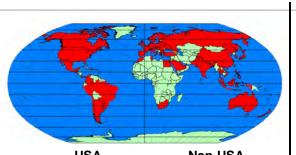
# **CMMI** Adoption

# CMMI Transition Status Reported to the SEI as of 10-31-10

| Training   |         |  |  |  |  |  |
|--|---------|--|--|--|--|--|
| Introduction to CMMI V1.2                          | 120,838 |  |  |  |  |  |
| Intermediate Concepts of CMMI                      | 3,238   |  |  |  |  |  |
| Understanding CMMI High Maturity Practices         | 636     |  |  |  |  |  |
| Introduction to CMMI V1.2 Supplement for ACQ       | 1,325   |  |  |  |  |  |
| Introduction to CMMI V1.2 Supplement for SVC       | 2,361   |  |  |  |  |  |
| Introduction to CMMI for Services V1.2             | 314     |  |  |  |  |  |
| Certifications                                     |         |  |  |  |  |  |
| Introduction to CMMI V1.2 Instructors              | 408     |  |  |  |  |  |
| CMMI-ACQ V1.2 Supplement Instructors               | 66      |  |  |  |  |  |
| CMMI-SVC V1.2 Supplement Instructors               | 131     |  |  |  |  |  |
| Introduction to CMMI for Services V1.2 Instructors | 23      |  |  |  |  |  |
| SCAMPI V1.2 Lead Appraisers                        | 466     |  |  |  |  |  |
| SCAMPI V1.2 High Maturity Lead Appraisers          | 142     |  |  |  |  |  |
| CMMI-ACQ V1.2 Lead Appraisers                      | 72      |  |  |  |  |  |
| CMMI-SVC V1.2 Lead Appraisers                      | 147     |  |  |  |  |  |

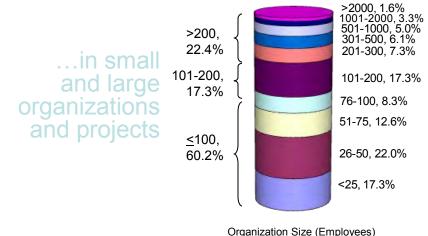
# **CMMI** Adoption

CMMI appraisals are conducted worldwide...



Commercial In-House Contractor for Military/Government Military/Government Agency

|   | U    | DA     | Non- | -USA   |
|---|------|--------|------|--------|
|   | Qty  | %      | Qty  | %      |
|   | 425  | 35.2%  | 3354 | 91.8%  |
|   | 651  | 54.0%  | 223  | 6.1%   |
| 1 | 130  | 10.8%  | 76   | 2.1%   |
|   | 1206 | 100.0% | 3653 | 100.0% |



#### ...in a wide range of businesses

#### Services (72.1%)

- · Business Services
- Engineering and Management Services
- · Health Services
- · Other Services

#### Manufacturing (15.7%)

- · Electronic and Electric Equipt
- Transportation Equipment
- Instruments & Related Products
- Industrial Machinery
- · Other Mfg Industries

#### Other (12.2%)

- · Finance, Insurance, Real Estate
- · Public Administration/Defense
- Transportation, Communication, Utilities

#### ...at all levels of process maturity

(4863 organizations reporting)

|                              | Commercial<br>In-House | Contractor for Military/ | Military/<br>Government<br>Agency |
|------------------------------|------------------------|--------------------------|-----------------------------------|
| No Rating Given              | 5.3%                   | 8.0%                     | 22.3%                             |
| Initial (ML1)                | 0.6%                   | 1.4%                     | 1.0%                              |
| Managed (ML2)                | 25.8%                  | 31.5%                    | 45.6%                             |
| Defined (ML3)                | 58.1%                  | 49.3%                    | 26.7%                             |
| Quantitatively Managed (ML4) | 2.9%                   | 1.0%                     | 1.5%                              |
| Optimizing (ML5)             | 7.2%                   | 8.9%                     | 2.9%                              |
| _                            | (3779 orgs)            | (874 orgs)               | (206 orgs)                        |

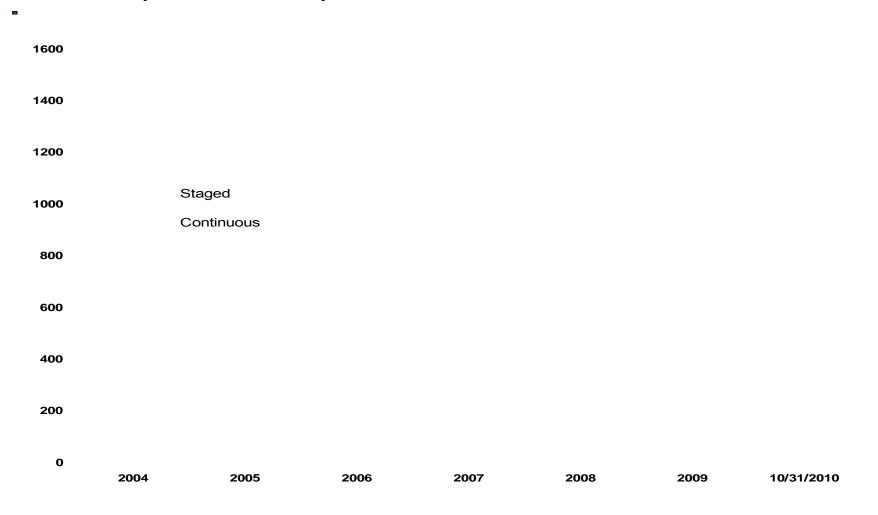
Source: SEI Process Maturity Profile, Sept 2010.

# CMMI V1.2 Foreign Language Translation Status Reported to the SEI as of 10-31-2010

| Language        | Status (for CMMI-DEV V1.2)                                  |
|-----------------|---|
| Japanese        | Completed August 2007. Intro course translated October 2007 |
| Chinese (trad.) | Completed December 2007                                     |
| French          | Completed August 2008                                       |
| German          | Completed April 2009. Intro course translated October 2009  |
| Spanish         | Completed in June 2009                                      |
| Portuguese      | Completed in May 2010                                       |
| Language        | Status (for CMMI-ACQ V1.2)                                  |
| Chinese (trad.) | Completed April 2009  |
| Language        | Status (for CMMI-SVC V1.2)                                  |
| Chinese (trad.) | Completed in July 2010                                      |
| Arabic          | To start, pending agreement                                 |
| Language        | Status (for CMMI-DEV V1.3)                                  |
| Dutch           | Underway  |

# Number of SCAMPI vX Class A Appraisals Conducted by Year by Representation\* Reported as of 10-31-10

\*Where Representation is reported



# **CMMI Model Structure**

Incremental Frameworks for Continuous Process Improvement

#### **Benchmark Ratings**

Goals

- Maturity Levels
- •Process Areas
- Capability Levels

#### **CMMI-DEV**

- Requirements Development
- Supplier Agreement Mgmt
- Technical Solution
- Product Integration
- Verification
- Validation

#### **CMMI-SVC**

- Capacity & Availability Management
- •Incident Resolution and Prevention
- Supplier Agreement Mgmt
- Service Continuity
- Service Delivery
- Service System Development
- Service System Transition
- Strategic Service Mgmt

#### CMMI-ACQ

- Agreement Management
- •Acquisition Requirements
  Development
- Acquisition Technical Mgt
- Acquisition Validation
- Acquisition Verification
- Solicitation and Supplier Agreement Development

## CMMI Model Foundation (Core Process Areas)

- •Requirements Management
- Project Planning
- Project Monitoring & Control
- Measurement & Analysis
- Configuration Management
- Process and Product QA

- Integrated Project Management
- •Risk Management
- Decision Analysis & Resolution
- Organizational Process Focus
- Organizational Process Definition
- Organizational Training

- Quantitative Project Mgmt
- Causal Analysis & Resolution
- •Org Process Performance
- •Org Performance Management

#### Institutionalization

- Policies
- •Plans
- Resources

- Responsibilities
- Training
- Managing Configurations

- Stakeholder Involvement
- Monitoring and Control
- Objective Evaluation
- Management Visibility
- Defined Process
- •Improvement Information

# **CMMI Product Suite, Version 1.3**

Version 1.3 focused on but was not limited to the following:

- High Maturity
- Appraisal efficiency
- Consistency across constellations
- Simplify the generic practices

Version 1.3 was change request (CR) driven.

# **Comparison of Models**

| Measure              | CMMI for Development |              |      | CMMI for Acquisition |      | CMMI for Services |      |      |
|----------------------|----------------------|--------------|------|----------------------|------|-------------------|------|------|
|                      | V1.1<br>Staged       | V1.1<br>Cont | V1.2 | V1.3                 | V1.2 | V1.3              | V1.2 | V1.3 |
| Pages                | 715                  | 710          | 560  | 468                  | 428  | 423               | 531  | 506  |
| Process<br>Areas     | 25                   | 25           | 22   | 22                   | 22   | 22                | 24   | 24   |
| Generic<br>Goals     | 2                    | 5            | 5    | 3                    | 5    | 3                 | 5    | 3    |
| Generic<br>Practices | 12                   | 17           | 17   | 13                   | 17   | 13                | 17   | 13   |
| Specific<br>Goals    | 55                   | 55           | 50   | 49                   | 46   | 47                | 52   | 53   |
| Specific Practices   | 185                  | 189          | 173  | 167                  | 161  | 163               | 182  | 181  |

Carnegie Mellon

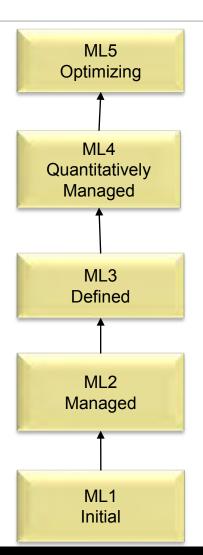
# **Achieving Maturity Levels**

GG 2 and GG 3 All ML2, ML3, ML4, and ML5 PAs

GG 2 and GG 3 All ML2, ML3, and ML4 PAs

GG 2 and GG 3 All ML2 and ML3 PAs

GG 2 All ML2 PAs



Prevent defects; proactively improve; insert and deploy innovative technology

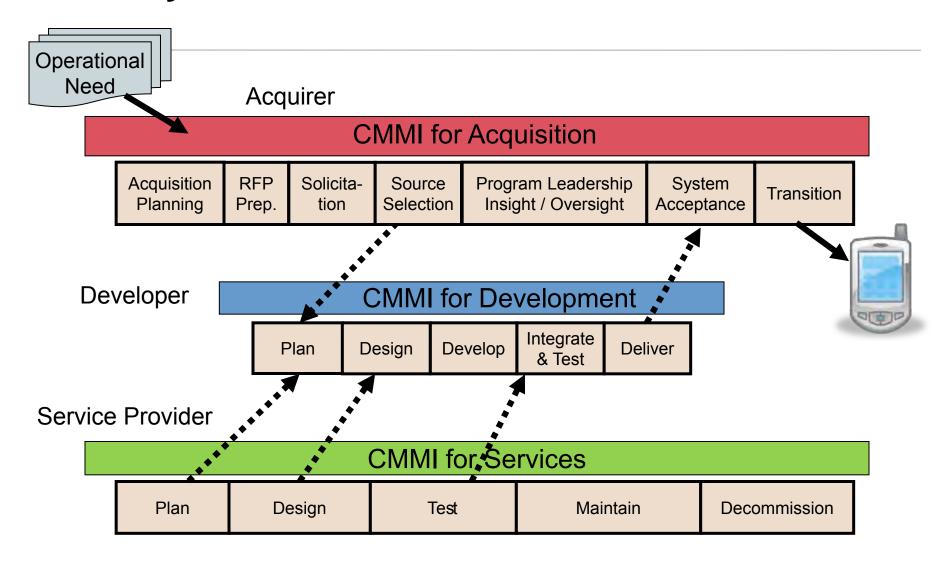
Measure process performance; stabilize process and control charts; deal with causes of special variations

Tailor the project's process from organization's standard processes; understand processes qualitatively; ensure that projects contribute to organization assets

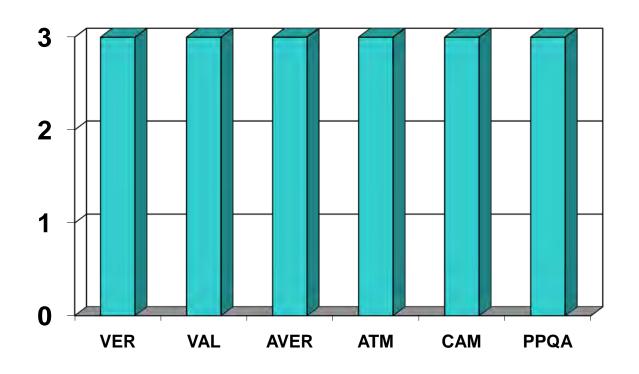
Adhere to policy; follow documented plans and processes; apply adequate resources; assign responsibility and authority; train people; apply CM; monitor, control, and evaluate process; identify and involve stakeholders; review with management

Processes are ad hoc and chaotic

# Visibility into the Team's Performance



# **Capability Profiles with Multiple Constellations**



# CMMI Appraisal Methods

# **Common Themes to SCAMPI Improvements**

#### Scoping Appraisals

- Confusion caused by "focus-" and "non-focus" projects
- Minimum scoping rules for a wide range of organization types

#### **Collecting Data**

 Confusion caused by "direct" and "indirect" artifacts

Software Engineering Institute

Data sufficiency

# Pain Points that Make SCAMPI Difficult to Sustain

- Need to achieve efficiency
- Expanding organizational scope
- True cost of PIIDs

#### Attaining/Maintaining Appraisal Ratings

- Period of validity
- Multi-constellation appraisals

# **Appraisal Transition**

#### Once CMMI Version 1.3 is released:

- During a period of one year, organizations may use either V1.2 or V1.3 models for their appraisals until November 30, 2011, except for uses dependent on translated versions of products that are approved in advance.
- SCAMPI A MDD V1.2 may be used until November 30, 2011.
- All appraisals will be valid for 3 years.

# **CMMI** Training

# **Training Updates**

## The following courses will be updated for Version 1.3:

- Introduction to CMMI-DEV
- Introduction to CMMI-SVC
- ACQ Supplement for CMMI-DEV
- SVC Supplement for CMMI-DEV
- SCAMPI Team Training & SLAT
- Advanced DEV courses

#### New courses:

- Development Supplement for CMMI-SVC
- Advanced courses for CMMI-SVC

# **Training Transition**

## The SEI will provide on-line upgrade training:

- Users make the transition by taking the upgrade course.
- Instructors make the transition by taking upgrade course.
- Lead Appraisers make the transition by taking upgrade course and specific SCAMPI method upgrade training.

# V1.3 CMMI Model Updates: Core PAs

# V1.3 Changes to GGs, GPs, and GP Elaborations

Positioned generic goals, generic practices, and GP elaborations in one central location as the first section of Part 2 in all three models.

Simplified GG1 to make it more readable.

Renamed GP 2.6 to "Control Work Products."

Added "selected work products" to the GP 2.9 statement.

Simplified the GP 3.2 statement to replace "collect work products, measures, measurement results, and improvement information" with "collect process related experiences."

Eliminated GG4 and GG5.

# **Core PAs: Support Category**

#### Configuration Management

Establish and maintain the integrity of work products using configuration identification, configuration control, configuration status accounting, and configuration audits

#### **Decision Analysis and Resolution**

Analyze possible decisions using a formal evaluation process that evaluates identified alternatives against established criteria

#### Measurement and Analysis

Develop and sustain a measurement capability used to support management information needs

## Process and Product Quality Assurance

Provide staff and management with objective insight into processes and associated work products

CM: Clarified that CM can apply to hardware, equipment, and other tangible assets.

DAR: Added guidance on **defining the scope of the decision** and
communicating results.

MA: More clearly distinguished between information needs and objectives, measurement objectives, and business/project objectives. Included a **table of examples** (as in ACQ) for DEV and SVC.

Clarified that PPQA also applies to organization level activities and work products.

# **Core PAs: Process Management Category**

#### Organizational Process Definition

Establish and maintain a usable set of organizational process assets, work environment standards, and rules and guidelines for teams

#### Organizational Process Focus

Plan, implement, and deploy organizational process improvements based on a thorough understanding of current strengths and weaknesses of the organization's processes and process assets

#### Organizational Training

Develop skills and knowledge of people so they can perform their roles effectively and efficiently

Converted goal on teaming to a single practice, which is no longer an "addition" for IPPD only.

Simplified SP 3.4 to replace "processrelated work products, measures, and improvement information" with "process related experiences".

Expanded applicability to training development and delivery methods such as self study, mentoring, and online training.

# **Core PAs: Project and Work Management Category -1**

#### **Integrated Project Management**

Establish and manage the project and the involvement of relevant stakeholders according to an integrated and defined process that is tailored from the organization's set of standard processes

## **Project Monitoring and Control**

Provide an understanding of the project's progress so that appropriate corrective actions can be taken when the project's performance deviates significantly from the plan

## **Project Planning**

Establish and maintain plans that define project activities

Simplified SP 1.7 to replace "work products, measures, and documented experiences" with "process related experiences."

Converted goal on IPPD or Integrated Teaming to a single practice (IPPD no longer an addition).

Added guidance for monitoring risks, data management, stakeholder involvement, project progress, and milestone reviews.

Added guidance on determining project lifecycle and milestones.

Added subpractices on determining data rights and need for configuration control, and determining communication requirements and other continuing resource needs.

# Core PAs: Project and Work Management Category -2

#### Requirements Management

Manage requirements of the project's products and product components and to ensure alignment between those requirements and the project's plans and work products

#### Risk Management

Identify potential problems before they occur so that risk handling activities can be planned and invoked as needed across the life of the product or project to mitigate adverse impacts on achieving objectives Changed the focus of SP 1.5 so that it now reads "Ensure that project plans and work products remain aligned with requirements."

Included examples related to: architectural risks, use of industry standards to identify risks, FMEA, and consequence monetization.

Provided guidance on maintaining risk parameters through life of the project.

## SAM – the Shared PA

| SG 1: | Establish | Supplier | Agreements |
|-------|-----------|----------|------------|
|       |           |          | 0          |

SP 1.1 Determine Acquisition Type

SP 1.2 Select Suppliers

SP 1.3 Establish Supplier Agreements

#### SG 2: Satisfy Supplier Agreements

SP 2.1 Execute the Supplier Agreement

SP 2.2 Accept the Acquired Product

SP 2.3 Ensure Transition of Products

Clarified the **applicability** of SAM practices.

**Demoted** SP 2.2 and SP 2.3 to subpractices of SP 2.1 and renumbered the remainder of the practices.

Revised SP 2.3 to allow its applicability to times when the product or service is delivered directly to the customer or end user from the supplier.

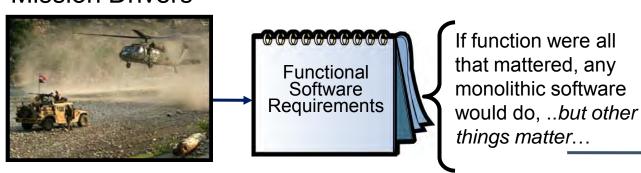
# **New Informative Material**

Update selected process areas to provide interpretation of practices for organizations with respect to the following topics:

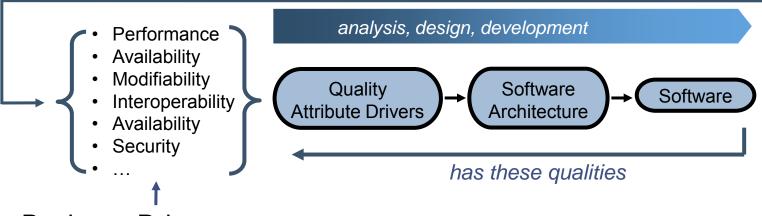
- Agile methods
- Quality attributes (i.e., non functional requirements or "ilities")
- Allocation of product capabilities to release increments
- Product lines
- System of systems
- Architecture-centric development practices
- Technology maturation
- Customer satisfaction

### **Software System Drivers**

### **Mission Drivers**



The important quality attributes and their characterizations are key.



**Business Drivers** 

## What about Agility?

Agility in acquisition and development, as with operational forces, requires a highly disciplined team.

### An agile team

- is trained
- is orchestrated
- has a plan
- knows when they deviate
- can predict the impact of changes
- measures and reports its own performance
- can respond quickly



## V1.3 Changes to High Maturity PAs

Many of the most significant changes to CMMI models as part of Version 1.3, are the changes to the high maturity process areas (CAR, OPM, OPP, and QPM).

These process areas are core process areas, but we've focused on these four over the others because of their significance in this release.

### **High Maturity Changes for V1.3**

### **Terminology Confusion**

- Common Cause (Statistical versus Quantitative Techniques)
- Process Models and Process Modeling
- Business Objectives
- Subprocesses

### Requirements implied versus explicit/ Explanations not central or consistent

Model/ Audit Criteria/ Presentations (Healthy Ingredients)/ UCHMP

### Perceptions

- Customers ML 5 is expensive no better than 3
- Industry ML 5 is NOT RIGHT for every business

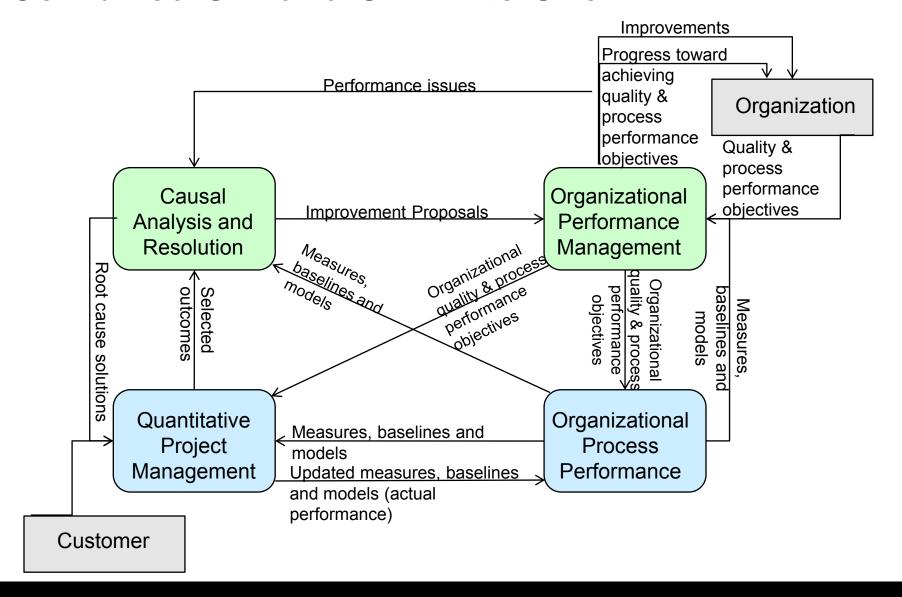
### High Maturity in ALL constellations

Examples are focused on Development

### **High Maturity Restructuring for V1.3**

- Insufficient link between process improvement, business objectives, and performance
- Clarify distinction between ML4 and ML5
- Eliminate GG4 and GG5
- Make CAR more relevant for organizational benefit

### **Combined OID and OPM into One PA**



### **Causal Analysis and Resolution**

SG 1: Determine Causes of Selected Outcomes

SP 1.1 Select Outcomes for Analysis

SP 1.2 Analyze Causes

SG 2: Address Causes of Selected Outcomes

SP 2.1 Implement Action Proposals

SP 2.2 Evaluate the Effect of Implemented Actions

SP 2.3 Record Causal Analysis Data

Used "outcomes" instead of "defects and problems."

Added **examples** for service organizations and for selecting outcomes for analysis.

Added **subpractices** in SP 1.1 for defining the problem, and in SP 2.2 for following up when expected results did not occur.

Added more information about **how PPMs can be used**.

Added emphasis on **prevention** and reducing recurrence.

### Organizational Performance Management

| SG 1:                     | Manag    | e Business Performance                           |
|---------------------------|----------|--|
| SP                        | 1.1      | Maintain Business Objectives                     |
| SP                        | 1.2      | Analyze Process Performance Data                 |
| SP                        | 1.3      | Identify Potential Areas for Improvement         |
| SG 2: S                   | elect Im | provements                                       |
| SP                        | 2.1      | Elicit Suggested Improvements                    |
| SP                        | 2.2      | Analyze Suggested Improvements                   |
| SP                        | 2.3      | Validate Improvements                            |
| SP                        | 2.4      | Select and Implement Improvements for Deployment |
| SG 3: Deploy Improvements |          |  |
| SP                        | 3.1      | Plan the Deployment                              |
| SP                        | 3.2      | Manage the Deployment                            |

**Evaluate Improvement Effects** 

Renamed the PA to be Organizational Performance Management (OPM).

Added a **new goal** about managing business performance using statistical and other quantitative techniques.

Provided more information about how improvements can be **selected for deployment**.

More explicitly described and discussed using process performance models.

Clarified that **not all improvement** validations include piloting.

SP 3.3

### **Organizational Process Performance**

#### SG 1: Establish Performance Baselines and Models

|   | Establish Quality and Process Performance Objectives |
|---|--|
| _ |  |

- SP 1.2 Select Processes
- SP 1.3 Establish Process Performance Measures
- SP 1.4 Analyze Process Performance and Establish Process Performance Baselines
- SP 1.5 Establish Process Performance Models

**Re-ordered SPs**, moving the old SP 1.3 (Establish Quality and Process Performance Objectives) to SP 1.1

Revised SP 1.4 to include **process performance analysis** and assessment of subprocess stability.

Revised SP 1.5 to note that under certain circumstances, projects may need to create their own process performance models.

Clarified the **relationship** of OPP to other high maturity process areas.

### **Quantitative Project Management**

| SG 1:   | Prepare   | e for Quantitative Management                    |
|---------|-----------|--|
| SP      | 1.1       | Establish the Project's Objectives               |
| SP      | 1.2       | Compose the Defined Process                      |
| SP      | 1.3       | Select Subprocesses and Attributes               |
| SP      | 1.4       | Select Measures and Analytic Techniques          |
| SG 2: C | Quantitat | ively Manage the Project                         |
| SP      | 2.1       | Monitor the Performance of Selected Subprocesses |
| SP      | 2.2       | Manage Project Performance                       |
| SP      | 2.3       | Perform Root Cause Analysis                      |
|         |           |  |

**Restructured** QPM so that SG1 focuses on preparation and SG2 focuses on managing the project.

Added **guidance** about using process performance baselines and process performance models.

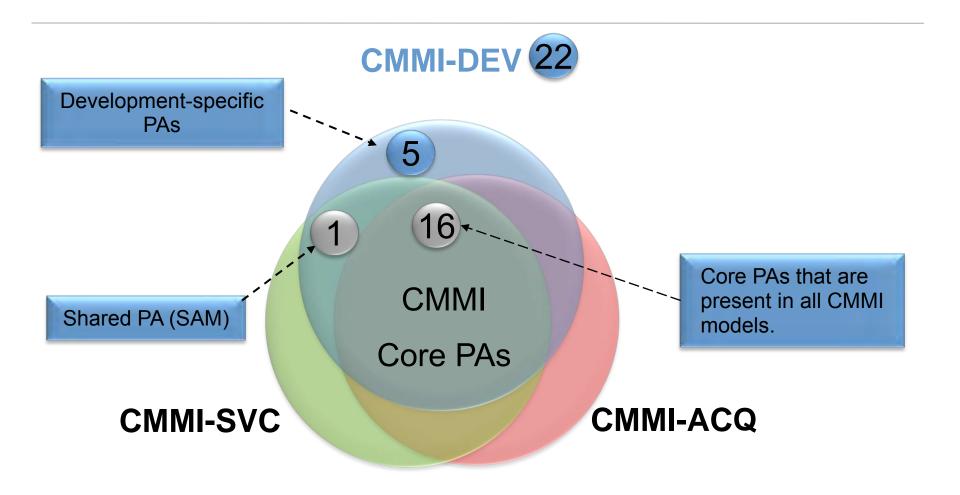
Define quantitative management in the glossary to include **statistical management** and use that definition for use of the terms throughout QPM.

Removed the practice about applying statistical methods to understand variation to reduce the over-emphasis on control charts.

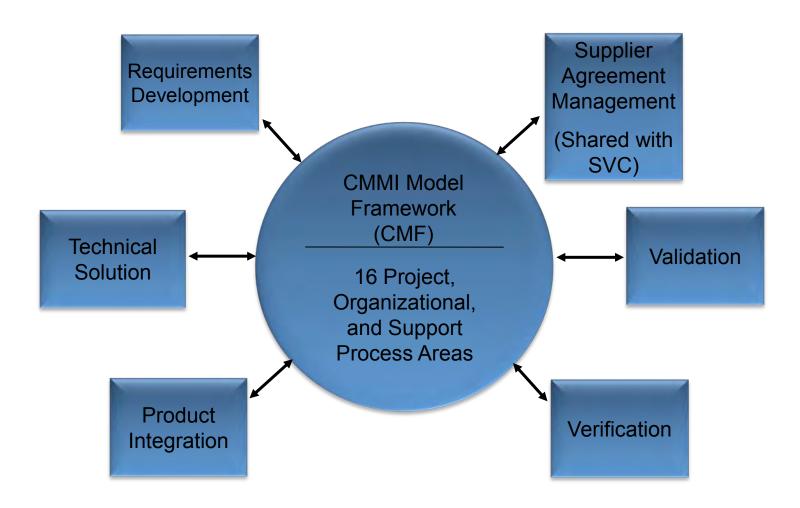
Added **new practices** about managing performance and performing root cause analysis.

## CMMI for Development

### **CMMI for Development Model**



## **Development-Specific PAs**



## **CMMI-DEV PAs by Maturity Level**

| Maturity Level |                        | Process Areas   |  |
|----------------|------------------------|---|--|
| 5              | Optimizing             | Causal Analysis and Resolution Organizational Performance Management  |  |
| 4              | Quantitatively Managed | Organizational Process Performance Quantitative Project Management  |  |
| 3              | Defined                | Decision Analysis and Resolution Integrated Project Management Organizational Process Definition Organizational Training Organizational Process Focus Product Integration Requirements Development Risk Management Technical Solution Validation Verification |  |
| 2              | Managed                | Configuration Management Measurement and Analysis Project Monitoring and Control Project Planning Process and Product Quality Assurance Requirements Management Supplier Agreement Management   |  |

## **CMMI-DEV PAs by Category**

### **Process Management**

Organizational Innovation and Deployment (OID)

Organizational Process Definition (OPD)

Organizational Process Focus (OPF)

Organizational Process Performance (OPP)

Organizational Training (OT)

### Support

Causal Analysis and Resolution (CAR)

Configuration Management (CM)

Decision Analysis and Resolution (DAR)

Measurement and Analysis (MA)

Process and Product Quality Assurance (PPQA)

For the V1.3 release, REQM was moved from "Engineering" to "Project Management."

oftware Engineering Institute

### **Project Management**

Integrated Project Management (IPM)

Project Monitoring and Control (PMC)

Project Planning (PP)

Quantitative Project Management (QPM)

Requirements Management (REQM)

Risk Management (RSKM)

(+) Supplier Agreement Management (SAM)

### Engineering

Product Integration (PI)

Requirements Development (RD)

Technical Solution (TS)

Validation (VAL)

Verification (VER)

### **Product Integration**

| SG 1: | Prepare for | Product | Integration |
|-------|-------------|---------|-------------|
|-------|-------------|---------|-------------|

- SP 1.1 Establish an Integration Strategy
- SP 1.2 Establish the Product Integration Environment
- SP 1.3 Establish Product Integration Procedures and Criteria

### SG 2: Ensure Interface Compatibility

- SP 2.1 Review Interface Descriptions for Completeness
- SP 2.2 Manage Interfaces

## SG 3: Assemble Product Components and Deliver the Product

- SP 3.1 Confirm Readiness of Product Components for Integration
- SP 3.2 Assemble Product Components
- SP 3.3 Evaluate Assembled Product Components
- SP 3.4 Package and Deliver the Product or Product Component

Revised the purpose statement to ensure proper **behavior** instead of proper function, thereby more explicitly including **quality attributes** and required functionality.

Changed emphasis on integration sequence to an emphasis on integration strategy.

Described an integration strategy and **how it relates** to an integration sequence.

### Requirements Development

| SG 1:   | Develop  | c Customer Requirements   |
|---------|----------|---|
| SP      | 1.1      | Elicit Needs  |
| SP      | 1.2      | Transform Stakeholder Needs into Customer Requirements                  |
| SG 2: D | evelop P | Product Requirements  |
| SP      | 2.1      | Establish Product and Product Component Requirements                    |
| SP      | 2.2      | Allocate Product Component Requirements                                 |
| SP      | 2.3      | Identify Interface Requirements   |
| SG 3: A | nalyze a | nd Validate Requirements  |
| SP      | 3.1      | Establish Operational Concepts and Scenarios                            |
| SP      | 3.2      | Establish a Definition of Required Functionality and Quality Attributes |
| SP      | 3.3      | Analyze Requirements  |
| SP      | 3.4      | Analyze Requirements to Achieve Balance                                 |
| SP      | 3.5      | Validate Requirements   |

SP1.2 revised to add that customer requirements should be **prioritized** based on their criticality to the **customer** and other stakeholders.

Broadened emphasis from "operational scenarios" to a more balanced "scenarios (operational, sustainment, and development)."

Added a focus on architectural requirements.

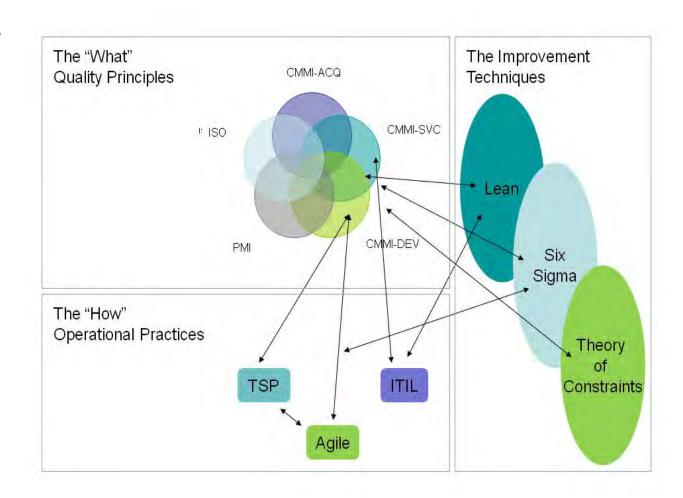
Because "Quality attributes" needs to be considered in addition to "functionality," SG3 and SP 3.2 were revised.

Added informative material that requirements can be monitored through development based on their criticality to the customer.

## CMMI and Other Models and Standards

### **CMMI Planned Elements: Multi-Model**

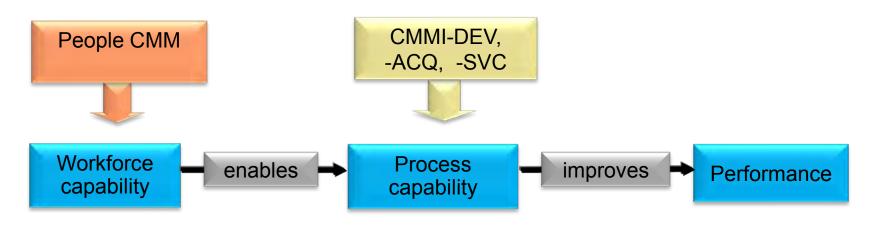
Improving interfaces is of interest to both government and industry....



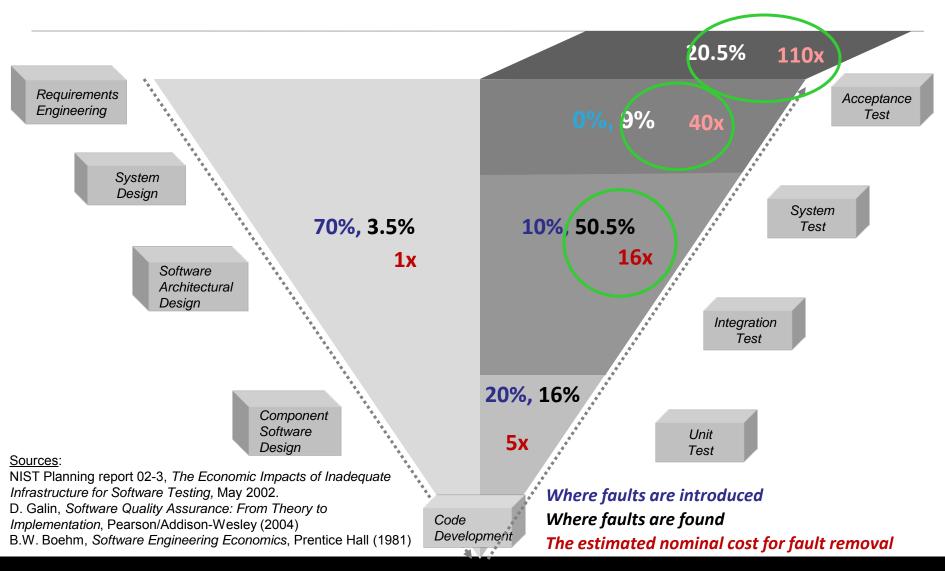
### **CMMI** and the People CMM

CMMI (DEV, ACQ, SVC) improves the **capability** of organizations' processes within specific domains.

The People CMM improves the **capability** of organizations' workforces through enhanced management and human capital. (*The People CMM defines capability* as the <u>level</u> of **knowledge**, **skills**, and **process abilities** available within each workforce competency of the organization to build its products or deliver its services.)



### **Late Discovery of System-Level Problems**







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# **Applying Theory of Constraints Tools to Focus Lean Development**

National Defense Industrial Association

10<sup>th</sup> Annual CMMI Technology Conference & User Group

Software Engineering Institute

Carnegie Mellon University

Tim Oltman
Boeing Defense, Space & Security
Wichita, Kansas

### Introduction

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### **Tim Oltman**

Boeing Defense, Space & Security Wichita, Kansas
Engineering Analysis & Integration Lean Engineering
Six Sigma Black Belt tim.j.oltman@boeing.com
Phone (316) 209-6183



Boeing Engineering Analysis & Integration Team (AIT) in Wichita Kansas, where he is responsible for Lean support of Lean+ 10X and process improvement projects across a variety of Engineering disciplines. Tim is Theory of Constraints International Certification Organization (TOCICO) certified in the Thinking Process tools, a Boeing Six Sigma Black Belt and heads the Wichita site Six Sigma Steering Committee. Tim has a B.S. in Industrial Engineering from the University of Nebraska and an M.B.A. in Operations Management from National University. Tim has over 25 years of Aerospace experience with General Dynamics, Raytheon and Boeing. Tim has been published and a presenter at the 1999 AEROFAST conference. Tim received an Institute of Industrial Engineers process improvement award for a Statistical Process Control project he implemented to reduce office process flow time.

## Theory of Constraints (TOC) Definition

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**TOC** is a management philosophy introduced by Dr. Eliyahu M. Goldratt in his 1984 book *The Goal*, that is geared to help organizations continually achieve their goal. Based upon the contention that any manageable system is limited in achieving more of its goal by a small number of constraints (& that there is always at least one). The TOC process seeks to identify the constraint and restructure the rest of the organization around it, through the use of the Five Focusing Steps.

### **Key Assumption**

The underlying assumption of TOC is that organizations can be measured and controlled by variations on three measures:

- Throughput is money (or goal units) generated through sales.
- Inventory is money the system invests in order to sell its goods and services.
- Operating Expense is all the money the system spends in order to turn inventory into throughput.

### Standing on the Shoulder's of Giants

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Theory of Constraints International Certification Organization www.tocico.org

# Dr. James R. Holt, PE Professor Engineering & Technology Management: Washington State University jholt@wsu.edu

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#### Eliyahu M. Goldratt

The Goal.
It's not Luck.
Critical Chain
Necessary but not Sufficient.
The Choice
Isn't it obvious



#### Its Not Luck, Eli Goldratt, 1997

This textbook /novel introduces the Thinking Processes and shows their application of the Thinking Process in many different environments

The Logical Thinking Process: A Systems Approach to Complex Problem Solving, H. William Dettmer, 2007

This is an excellent Theory of Constraints Handbook

## Applying Theory of Constraints Tools to Focus Lean Development

- Introduction to Theory of Constraints
- How to use the Thinking Process Tools
  - What to Change
    - Evaporating Clouds to identify conflicts
    - Current Reality Tree
  - What to Change to
    - Strategic Future Reality Tree
  - How to cause the Change
    - Prerequisite Trees and Transition Trees
    - Strategy and Tactics Tree

## Theory of Constraints Basic Facts

- Every system is part of a larger system
- Every system has sub-systems
- A system is made up of individual elements that are linked in some interdependent fashion
- Within any complex system there is one constraint (or very few) of several possible types
  - Every system has a limiting factor, else growing systems would soon explode
- It is always possible to find the constraint and exploit it or improve it

## The Five Focusing Steps

- 0. What is the Goal
- 0.5 How to Measure Progress toward Goal
- 1. Find the System Constraint
- 2. Decide How to Exploit the Constraint
- 3. Subordinate everything else to the Constraint
- 4. Elevate the constraint
- 5. If the constraint moves, start over at Step 1

## Constraints Management

- In physical systems (machines, production, distribution, ...) the constraint is relatively easy to find
- In non-physical systems (social systems, service organizations, interactions, relationships, selfgoverning, not-for-profit, creative groups, ...) it is harder to find
- While we can often change our minds faster than changing equipment, getting EVERYONE to change their minds at the same time, is pretty hard

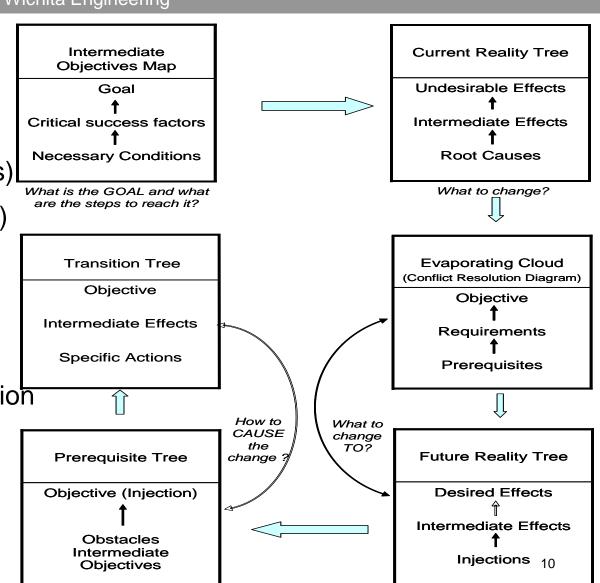
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## **TOC Thinking Processes: Constructs**

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- Evaporating Clouds(Conflict, 3 clouds, CCC)
- Assumptions
- Undesirable Events (UDEs)
- Current Reality Tree (CRT)
- Injections on CCC
- Desirable Events
- Future Reality Tree (FRT)
- Negative Branch Reservation
- Prerequisite Tree (PRT)
- Transition Tree (TT)



Source: The Logical Thinking Process, H. William Dettmer, 2007

## Different Logic Patterns

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- Logic: There are two main types of logic: Sufficiency-Based logic and Necessary-Based Logic
   I have a Dog
   I have an Animal
- With sufficiency based logic, we read in the direction of the arrow and say IF A, THEN B, we mean, "It is sufficient that if A exists, then B exists." IF I have a dog, THEN I have an animal. Having a dog is sufficient to satisfy the conclusion that I have an animal. This is common sense
- With necessary based logic, we read against the arrow and say, In Order To C, I Must Have D. In Order To make a fire, I Must Have combustible material. This is also common sense. Can you have a fire without combustible material?

A Fire Combustible Material

- These two different types of logic are often confused, but shouldn't be. One is forward thinking, the other is backwards thinking. They are Different
- IN ORDER TO have an animal I MUST HAVE a dog. Is that common sense? No, I could have a cat. IF I have combustible material THEN I have a fire. Is that common sense? No, there are other things necessary to have a fire. The categories of legitimate reservation make sure the logic is solid

## Alternating Logic Types

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- The Theory of Constraints Thinking Processes use both necessary and sufficient logic. In examining the logic tools closely, you see the tools alternate the logic types. The CRT, FRT and TT use sufficiency based logic. The EC and PRT use necessary based logic. This clever alternating logic causes the final conclusion to not only be necessary but also sufficient--the solution will be the minimum set of required conditions to be sufficient to assure success.
- These two, common logic types each discover causality in different ways. By alternating them, we clarify and better understand. We recognize that all dogs are animals. And, we need heat and oxygen besides combustible material to create a fire. The use of both makes our thinking process <u>robust</u>, forgiving and <u>reliable</u>. Using them both will help you discover new knowledge.
- Some people claim necessary based logic is right brained and sufficiency based logic is left brained. Maybe getting both sides of the brain to work together will be a boon! Anyone can learn necessary based logic. It just takes practice.

source: Washington State University-2010

## Applying Theory of Constraints Tools to Focus Lean Development

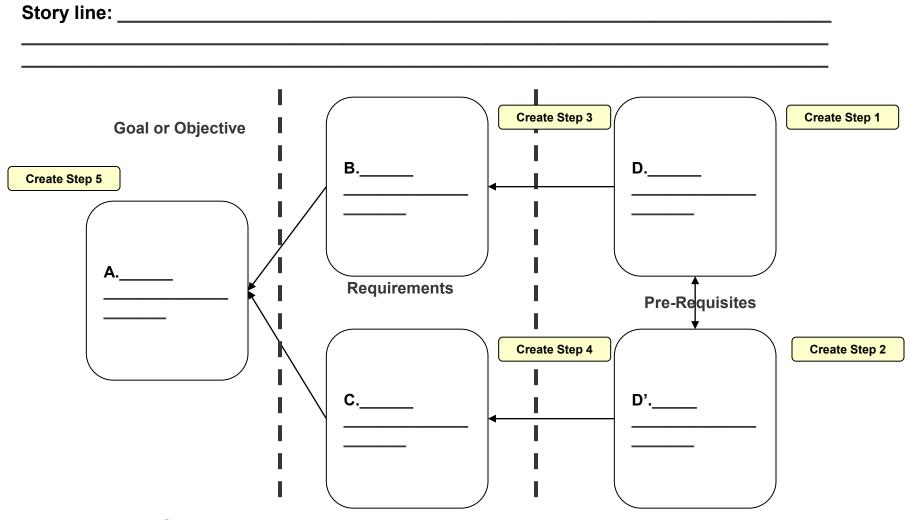
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## Evaporating Clouds are Necessary-Based Logic

- Necessary based logic is the basis for the Evaporating Cloud (Conflict Resolution Diagram as Dettmer calls it). What are the necessary conditions to achieve the goals we desire? What are the prerequisites for the necessary conditions?
- The Evaporating Cloud is used to <u>surface intuition</u>, <u>generally accepted assumptions</u>, <u>unspoken understanding</u>, and <u>established rules</u>.
  - These areas (assumptions behind the necessary logic arrows) then become targets for challenge / change/improvement.
  - The traditional assumptions limit the range of solutions to our problems.
  - If the traditional assumptions can be made invalid, then we have found a place where the necessary conditions no longer hold.
  - We call such a discovery, a breakthrough injection.
- The Evaporating Cloud is the most easily used logic tool. It can be used everyday to develop understanding, facilitate communication and resolve every-day conflict. Students of the Thinking Process should learn to create Evaporating Clouds in minutes. It is most better to resolve conflicts quickly, before they become chronic

## Here is an Evaporating Cloud Worksheet

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source: Washington State University-2010

### Guidelines for Creating and Evaporating Cloud

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As soon as you recognize there is no room for an acceptable compromise (there is a breakdown in communication, the other side is becoming stubborn and illogical or our relationship is in jeopardy) take a break. During the break:

### 1. Write down WHAT I WANT (D.)

You know this. You keep repeating it over and over out loud and in your thoughts. (Usually, this is an action or result of an action)

### 2. Write down WHAT THE OTHER SIDE WANTS (D'.)

You know this. They keep repeating it over and over trying to convince you.

### 3. Write down WHAT NEED I AM TRYING TO SATISFY. (B)

You may have to stop and think hard here. Why is it you NEED the thing you want?

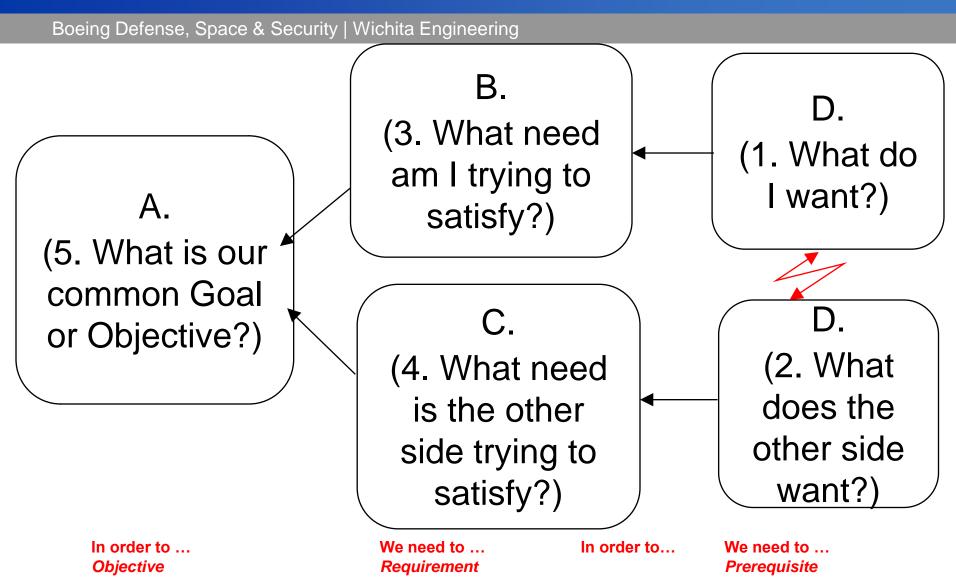
### 4. Write down WHAT NEED THE OTHER SIDE IS TRYING TO SATISFY. (C)

If you don't know, you haven't been listening to the other side. Think! What was their justification for their desires? That was their need?

### 5. Write down OUR COMMON OBJECTIVE. (A)

Yes, you have one. You are still talking! What is the reason you are still talking to this hard headed, obnoxious, uncooperative person on the other side? What do you both want to have? What goal do you both need to satisfy? Why is it you are trying so hard to convince the other side to cooperate?

## Creating the Evaporating Cloud



### **Focusing Lean Support Group** Core Conflict Cloud

Story line: The company has limited resources to perform "Process Improvement" and support internal customer needs for Change and Improvement. These "change agents" are tasked with working with Employee Involvement Teams to create a culture of process improvement. There is an effort underway to explore TOC as an improvement tool.

Train TOC folks on how they can benefit from LEAN (to improve the difficult processes they find - in CCPM for sure - and other Combine LEAN and TOC for fast, surgical results! bottleneck areas). **Assumptions Assumptions** Our current date driven scheduling causes us to have to do project rescheduling 1. There is pressure to try something better than what we have been doing There is pressure to try something better than what we have been doing Our customer has changing requirements we need to improve our processes The customer wants products faster and cheaper TOC takes in to account delays and resources availability Difficult to schedule today what is going to occur more than 6 months in the TOC is a good way to create process that are adaptive future Dc.' Our project requirement are not all the same 1. Take radical, unproven (to me), experimental procedures Bc. 3 Do things that deliver Use the Thinking Tools Process to establish significant results quickly priorities for Process Improvement Projects Assumptions We don't know where to focus resources Ac. Implementing both concepts causes confusion 5 Dramatically improve our Lean and El don't always deliver desired results Focus resources on where the highest savings are (largest processes Not everyone knows TOC improvement can be made - that contribute to Throughput immediately (or accelerate project management processes) Cc. Dc. 4. Do mature, correct things that have 2. Use the best LEAN tools and proven to be very effective over time techniques, El (Employee Involvement) **Assumptions** We need to improve our processes **Assumptions** Stable processes makes jobs easier to manage Toyota like methods have been up to this point the company accepted method We know how to control stable process for continuous improvement. If we change we might create an unstable process Toyota is considered to be successful with their implementation of Lean **Processes** The accepted site improvement methodology has been El Train Lean Facilitators on There is a method to create and maintain stable It is easier to stay with the current culture TOC balanced processes (We become a fast, reliable El teams are easy to measure and control source of expert knowledge and projects. We can Find other ways to implement Employee Involvement Create meaningful improvement pick and choose which, of many, contracts we will metrics associated with Increasing (remove the obstacles to being fast and let the work pursue. We are profitable. We can grow our Value and decreasing Time capacity at a rate we choose. itself be the reward)

In order to ... **Objective** 

We need to ... Requirement

In order to...

We need to ... **Prerequisite** 

### **CLRs**

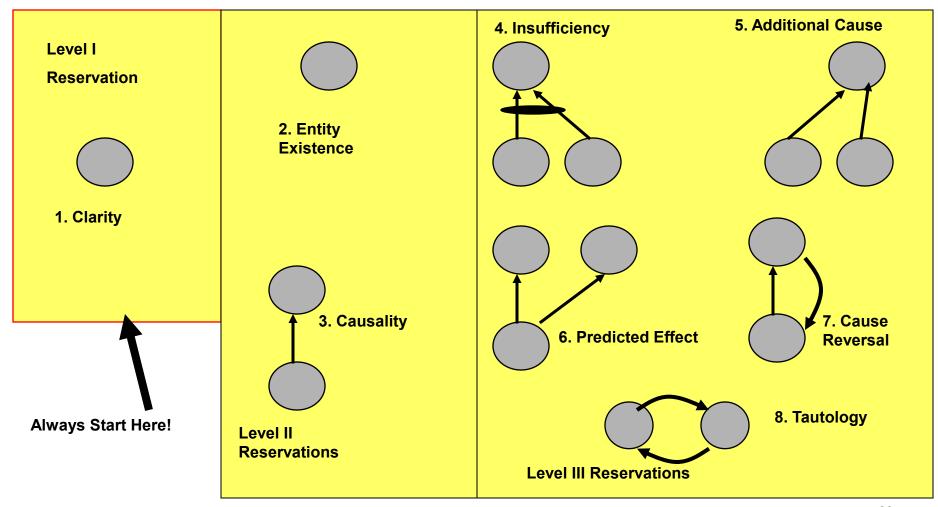
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### **CLRs – Categories of Legitimate Reservation**

- Are tools to rigorously evaluate and critique (scrutinize) logic statements in a non-threatening manner
- Ensure the logic is solid
- Help solidify intuition or emotion into solid cause-effect relationships
- Force the discovery new knowledge to correct logical errors
- The Categories of Legitimate Reservation are the tools to validate or invalidate any argument. They are very powerful when applied in a systematic way. They are the tools to discover the underlying assumptions.

### **Categories of Legitimate Reservation**

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### Scrutiny!

- What is Scrutiny?
- We want to examine each logical arrow according to <u>eight logic</u> rules (CLRs).
- Taken together with your intuition, they are sufficient to demonstrate the truth of your logical connections.
- Or, they will surface legitimate reservations about the logic.
- Anytime a reservation is surfaced and addressed, additional knowledge is gained. DISCOVERY!
- Use Scrutiny to gain deeper understanding/discovery.
- Use it on yourself and with others. Encourage them to scrutinize you!

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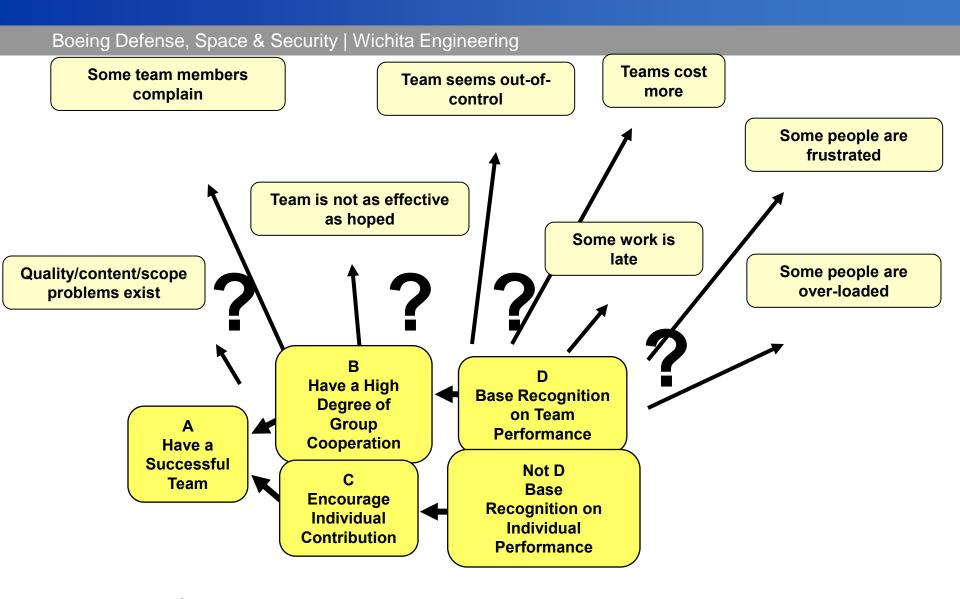
### Creating a Current Reality Tree from UDE

- UDEs Undesirable Effects
- Let's approach these UDEs and the whole world of Team Management by taking three different situations (one UDE clouds) and combining them.
- Development (or Design) / Business / Education
- Other areas would have worked just as well; these are good enough

### **UDEs of Lean Support Group**

- The majority of BDS leadership has the perception that lean does not generate results.
- \*Employee Involvement has not produced the results desired
- \*Lean has not produced the results desired
- \*Leadership is hesitant to apply lean to a business problem.
- \*Lean results do not show up in EAC
- \*Leadership feels leading Lean is not a valuable way to spend their time.
- \*Leadership fears using Lean because of fear of not being able to proved the expected improved financials.
- \*Lean facilitators are most comfortable with soft skills facilitation / training and not driving teams to achieve significant improvement fast
- \*Lean facilitators are not comfortable not driving teams to achieve significant improvement fast.
- \*Lean facilitators are conflict adverse..
- \*Lean facilitators become ineffective when having to lead real change.
- \*People are confused at which measure to follow
- \*People are frustrated
- \*People are not happy (satisfied) with their work
- \*The site is not performing as well as it should
- \* Lean facilitators are not sure which metrics to track and follow
- \*There is general confusion about what the goals and objectives are
- \*There is a general lack of focus and direction
- \* Lean facilitators are not supporting all the needs of the customers
- \*Employee Involvement is not capturing as much savings as possible
- \*There is conflicting direction from matrix chain of command
- \*There is lack of emphasis on improvements that impact the bottom line
- \*There is confusion on which tools and techniques to use

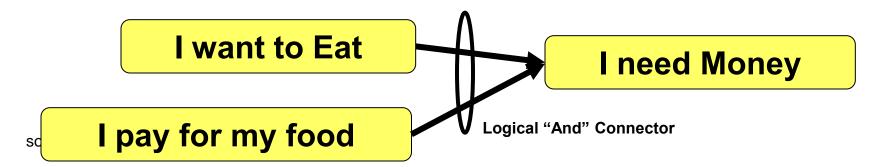
### Does this Conflict seem to CAUSE all the UDEs?



### Behind Every Arrow, There is an Assumption

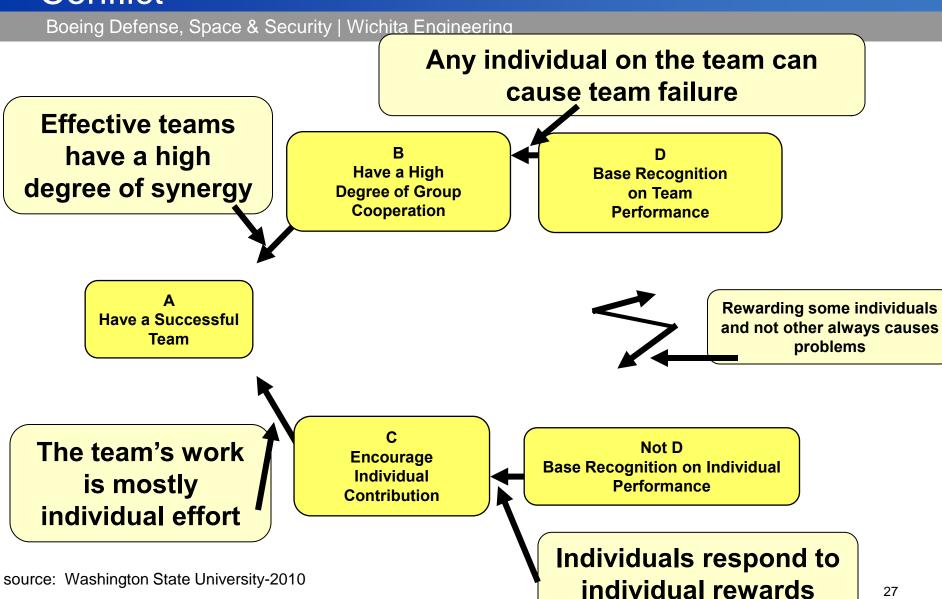
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• The assumption in Necessary Based logic was: "In order to Eat, I must have Money Because I pay for my food."



- The assumption in Sufficiency Based logic is the same but is structured slightly differently:
  - "If I want to eat, And I pay for my food, Then I need money."

# Some Assumptions Behind the Arrows of the Core Conflict



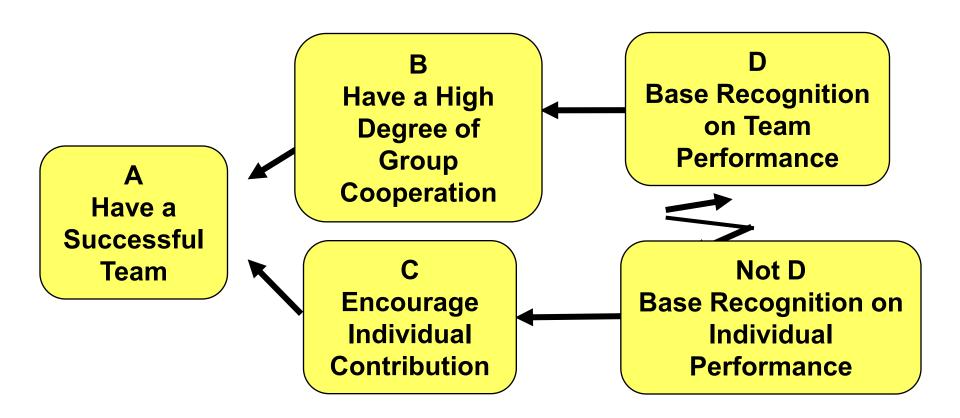
# Converting the Evaporating Cloud to Current Reality Tree

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- The next few steps are Dramatic Ones:
  - Stand the Cloud on its point.
  - Turn around the arrows
  - Adjust the wording to make smooth "If ... Then ..." logic
  - Add the Assumptions with the 'And' Connectors
- The result is the start to the Current Reality Tree!

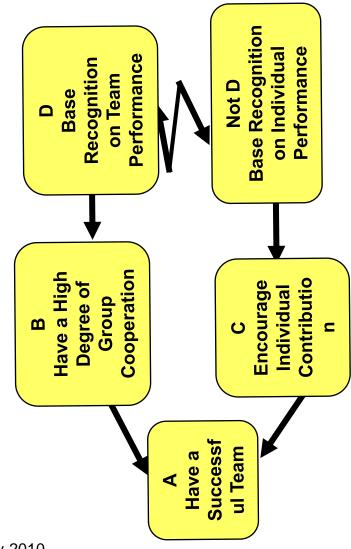
### Start with the Conflict Cloud

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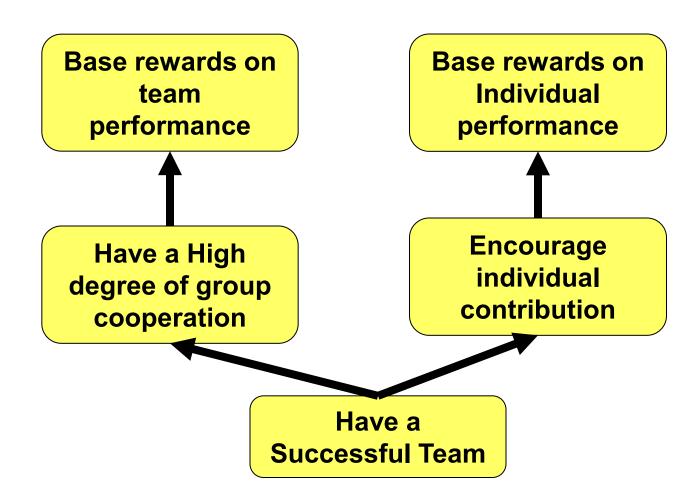
## Flip in on it's end

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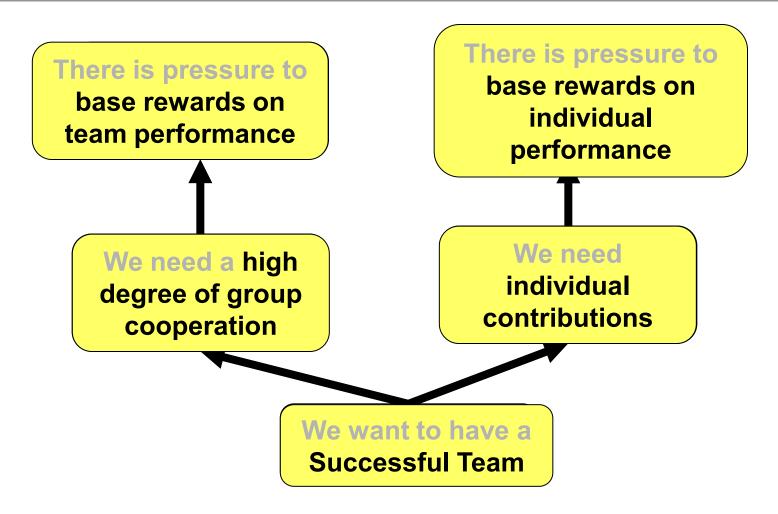


### Turn the Arrows Around

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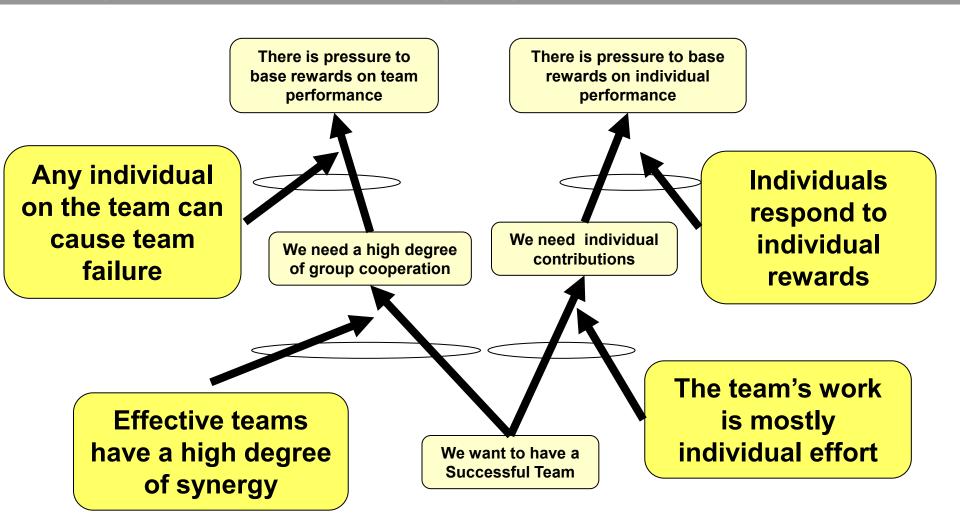


## Adjust the working to "If ... Then ..." Logic (note the key words added to make this easier – include them)



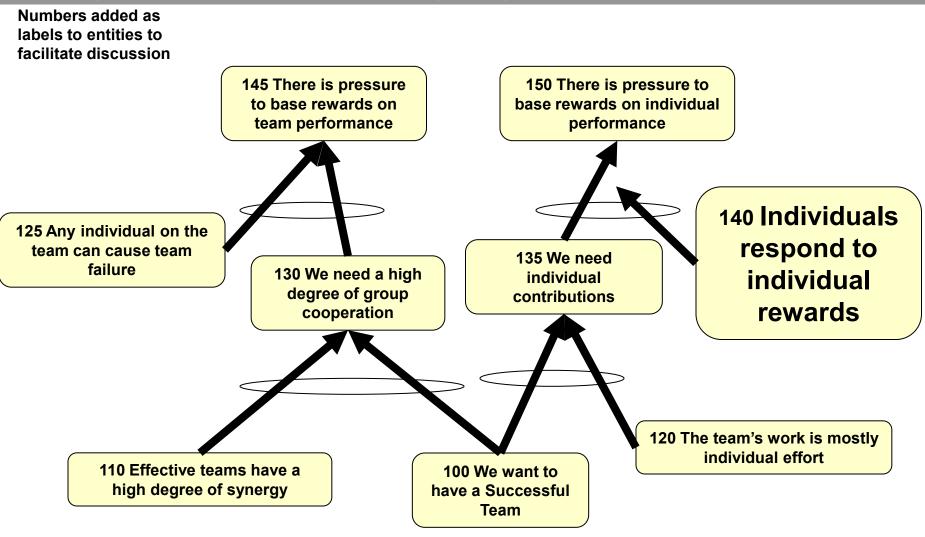
### Add in at least one Assumption for each arrow

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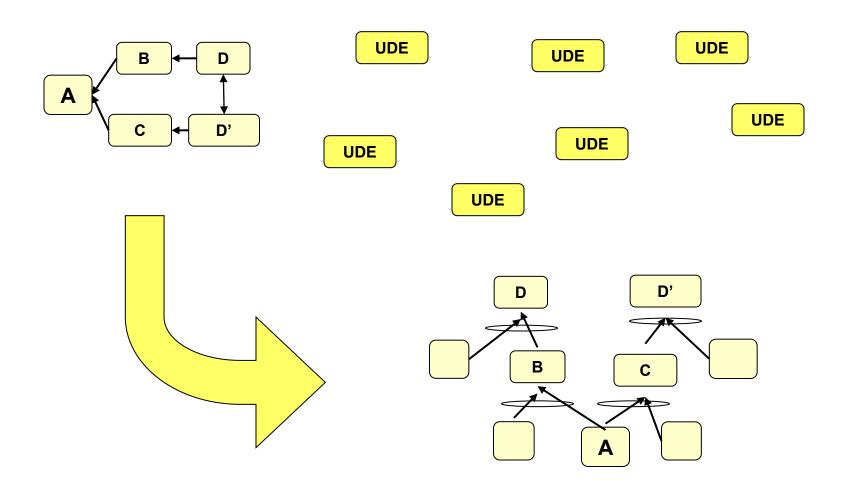


# Check the Logic using the Categories of Legitimate Reservation

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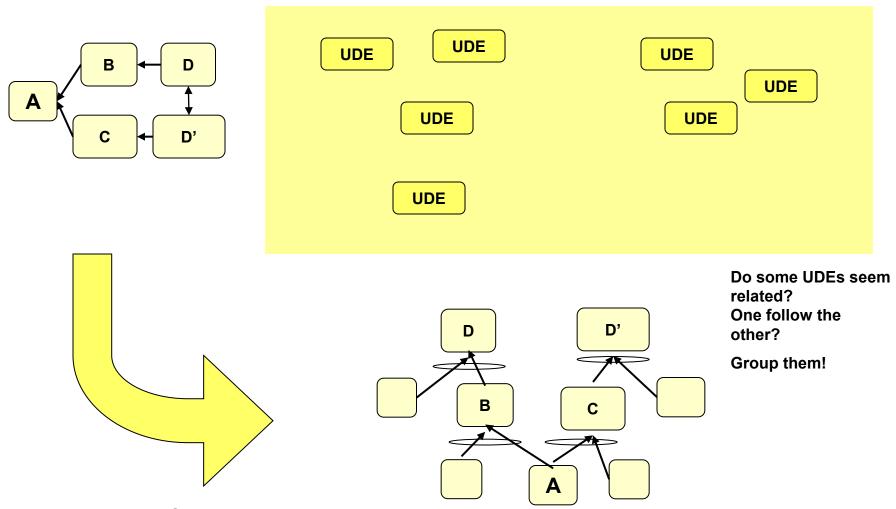


# Connect the Core Conflict to the UDES for the CRT foundation



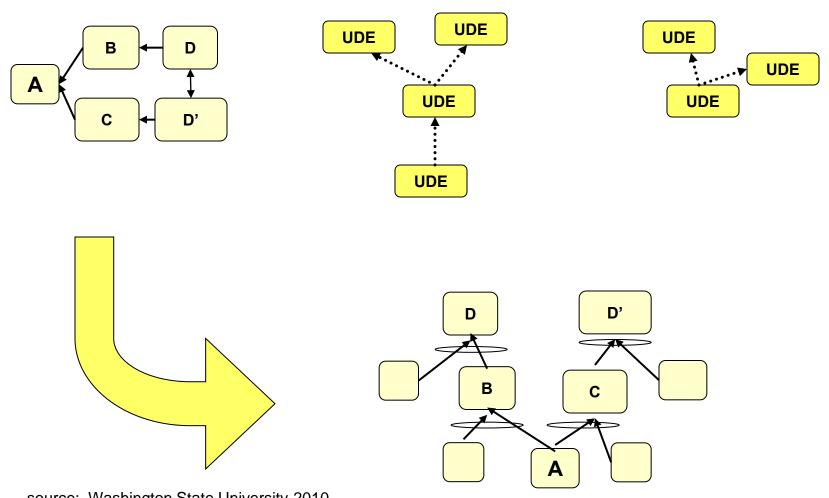
## Starting Groups and Connections

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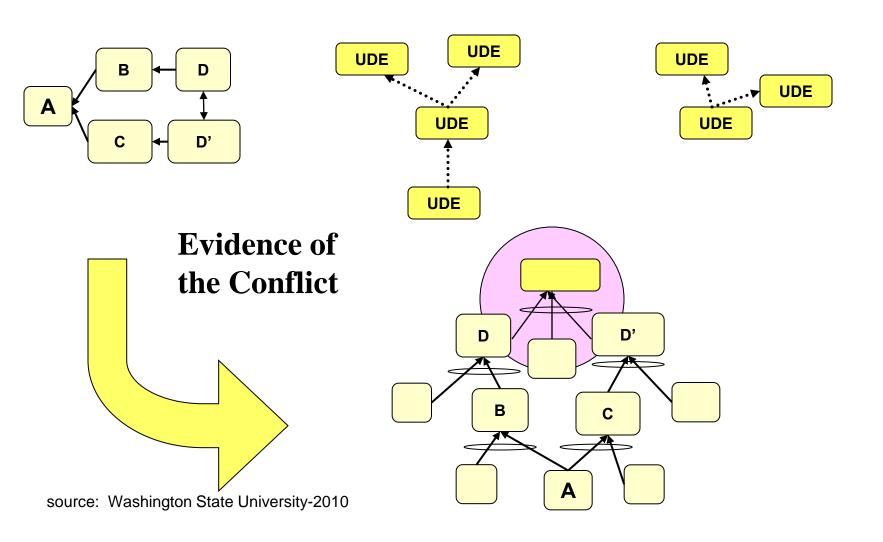


## Simple, Temporary Connections

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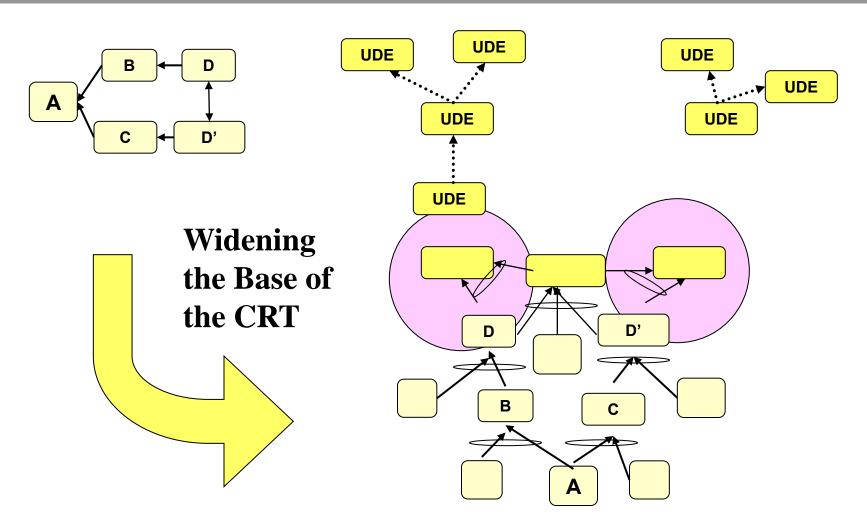


### Look for the Result of the Conflict

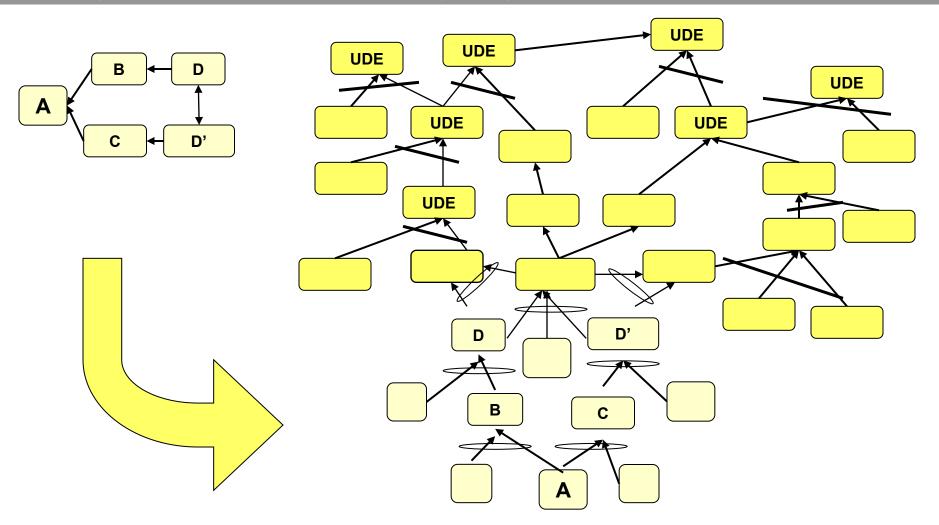


### What Happens because of the Conflict and D/D'?

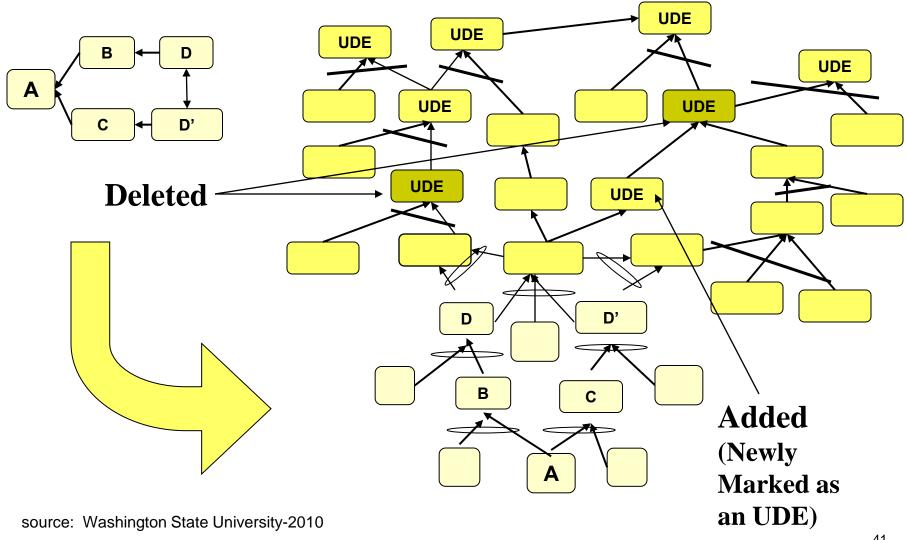
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### Scrutinize the Entire Tree Using the CLR

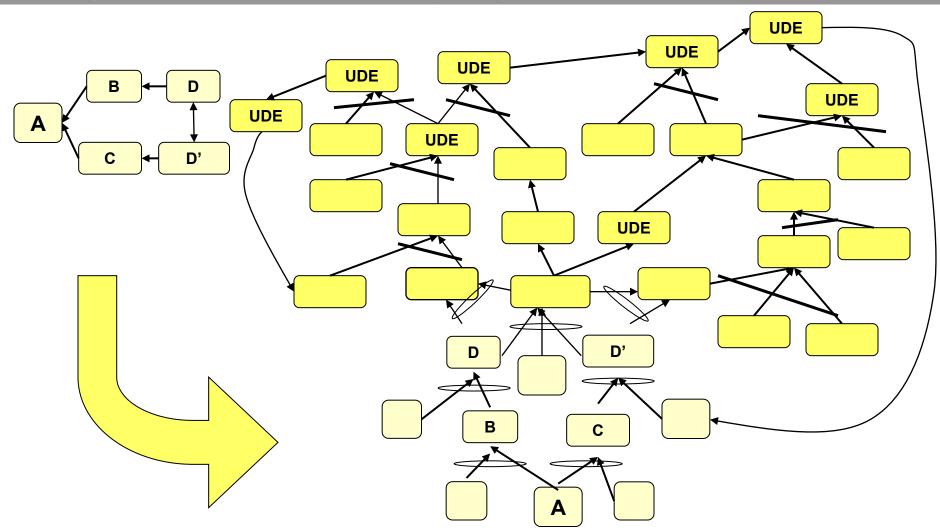


### Re-Evaluate the UDES-Find New Ones/Delete Old Ones

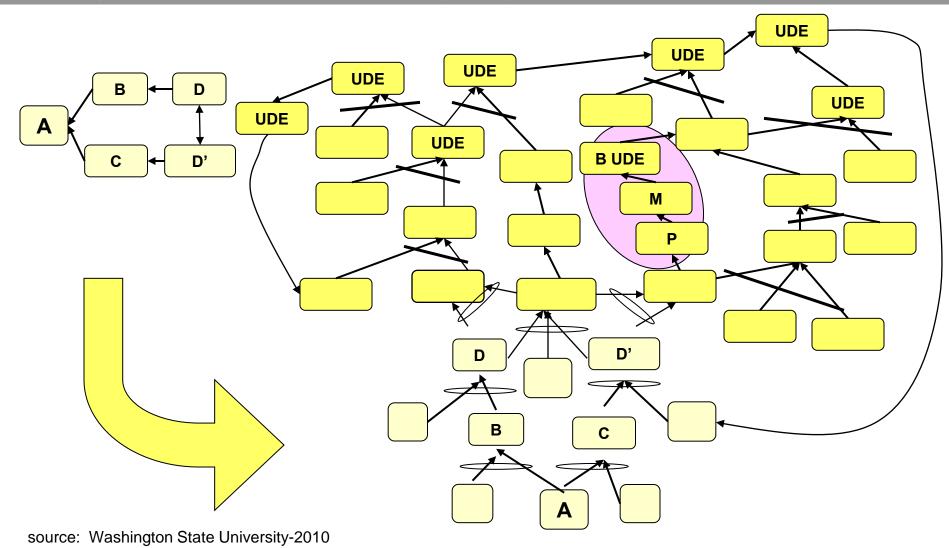


## Look for Feedback Loops

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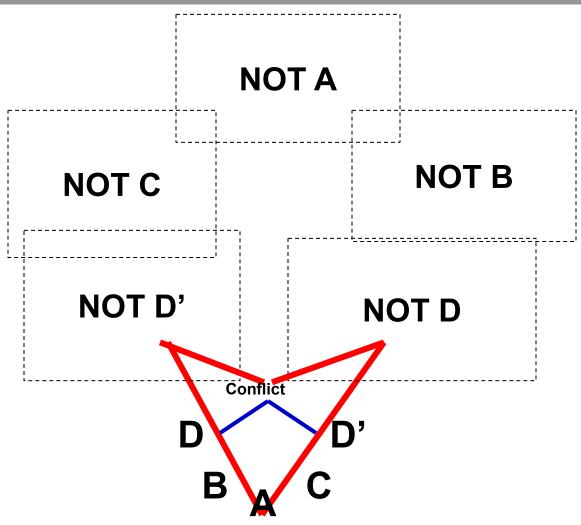


# Look for Policy, Measurement, Behavior Issues (add them if they are not there)

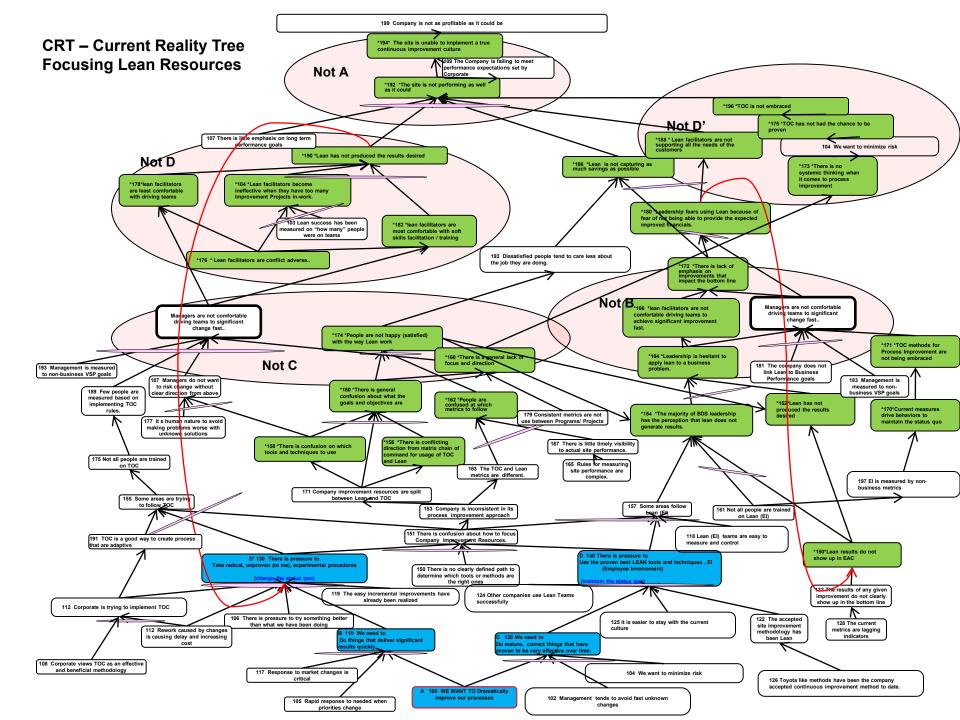


### The Cone Shape Then Becomes...

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- The addition to the Base divides the CRT quickly
- Builds upwards quickly
- The Regions help show what is missing
- Allows a Thinking
   Process person to view
   the CRT and Scrutinize
   Quickly



# Applying Theory of Constraints Tools to Focus Lean Development

- Introduction to Theory of Constraints
- How to use the Thinking Process Tools
  - What to Change
    - Evaporating Clouds to identify conflicts
    - Current Reality Tree
  - What to Change to
    - Strategic Future Reality Tree
  - How to cause the Change
    - Prerequisite Trees and Transition Trees
    - Strategy and Tactics Tree

### The Future Reality Tree

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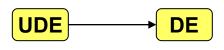
- The FRT is NOT detailed. It's a HIGHer order of abstraction
- Its purpose is to affirm direction and build confidence
- Don't get caught up in too much minutia! Make it High Level & Logically Sufficient
- The PRT and TT will do the detail work later.
- The Core Conflict already raised your thinking to a higher level of abstraction from the UDES. Let the FRT stay near that level
- Still, you need enough detail to achieve the DEs

### Convert UDEs to DEs

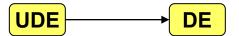
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Convert the Undesirable Entities into a Positive Desirable

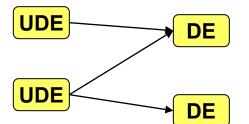
Effect.



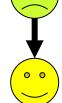






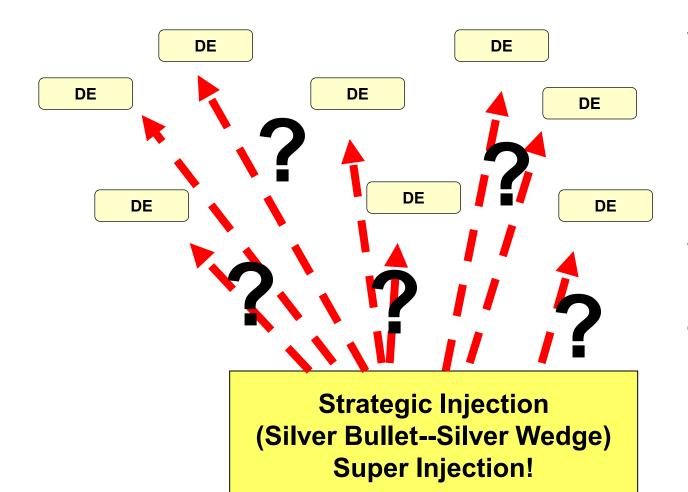


- UDE: Behind the Scenes maneuvering (politics) is common
- DE: People are very cooperative
- UDE: People are frustrated
- DE: People are happy on the job
- UDE: Many people are valued some what arbitrarily
- DE: People know their
   \_contribution will be appreciated



### Reaching our Future

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We want to create our Desired Effects (opposites of our UDEs)

Will the Silver Bullet get us there?

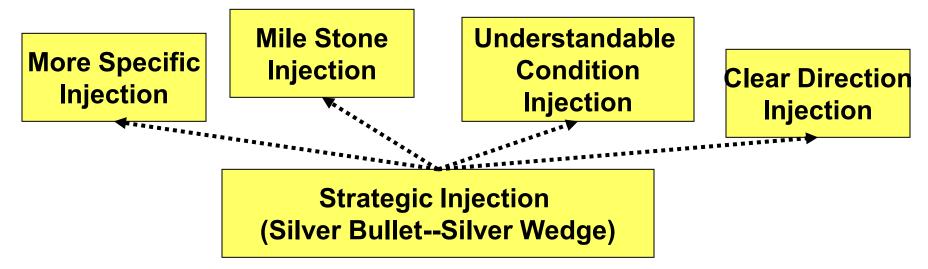
## Finding Breakthroughs (the next step)

- Breakthrough Solutions are <u>Silver Bullets</u> (or at least <u>Silver Wedges</u>, powerful wedges that only need a crack in the wall to allow us to "work our way through").
- How do we find them?
  - By Observation
  - By Challenge
  - By Reference Environment
- The best are often The Impossible Ones
- If you can't find one, Just do the Opposite of the Rest of the World.

### Relationship of the Super Injection

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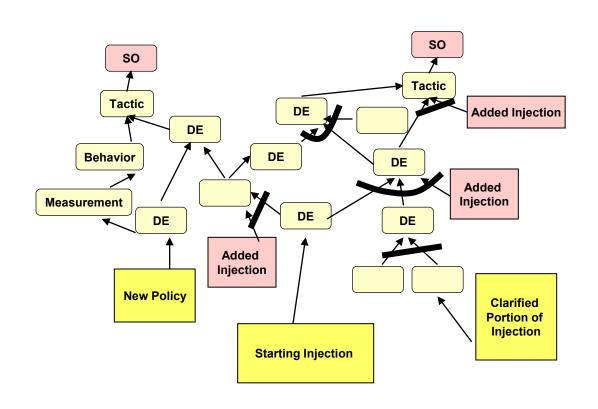
- The Super Injection, may represent the strategic direction.
- In order to build a solid FRT, it may need to be broken into it's component parts. The definition of the component parts then assist in the development of the FRT.

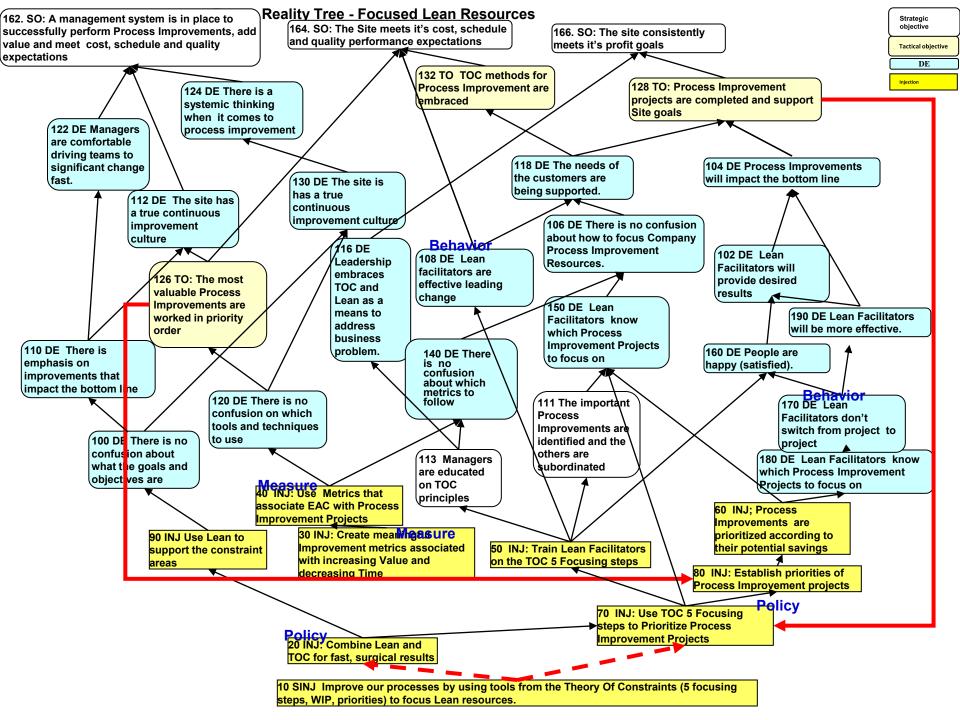


### The Resulting Future Reality Tree

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The FRT gives the road map that confirms we are on the right track. It shows our injection(s) can succeed. It gives confidence and direction in moving into the future.





# Applying Theory of Constraints Tools to Focus Lean Development

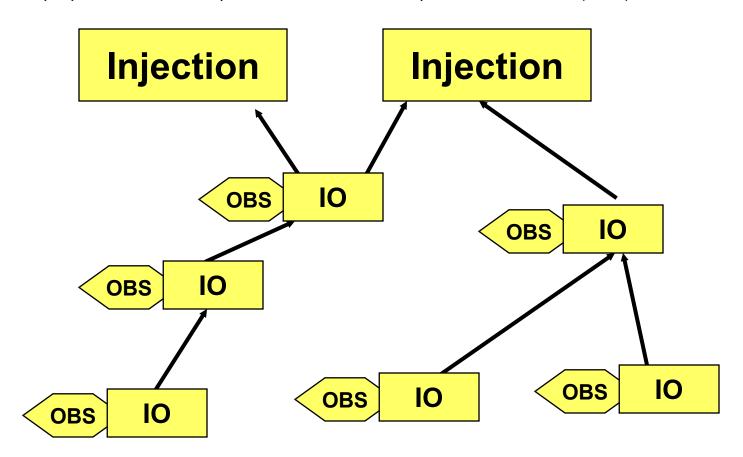
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- Introduction to Theory of Constraints
- How to use the Thinking Process Tools
  - What to Change
    - Evaporating Clouds to identify conflicts
    - Current Reality Tree
  - What to Change to
    - Strategic Future Reality Tree
  - How to cause the Change
    - Prerequisite Trees and Transition Trees
    - Strategy and Tactics Tree

### The Prerequisite Tree

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The purpose of the Prerequisite Tree is to surface potential obstacles (OBS) to be overcome



**Use TOC 5 Focusing steps to Prioritize Process Improvement Projects** 

| Obstacle  | Tactical (Intermediate) Objective  |
|---|--|
| Lean Facilitators and Management don't know about the benefits of TOC                 | Train Lean Resources on TOC  |
| Process with constraints are not identified or managed                                | identified and managed the priority Process Improvement projects   |
| Key Lean Facilitators are overloaded  | Support the Lean Facilitators working the priority Process Improvement projects                                      |
| The capacity of the Lean Facilitators working Process Improvement projects is unknown | Identify constraints in current Lean assignment processes. Then subordinate all other Process Improvement projects . |

#### Limit the number of Lean Projects being worked at any time

| Obstacle   | Tactical (Intermediate) Objective  |
|--|--|
| Bad Multi-tasking of Process Improvement Projects is allowed and even encouraged               | Eliminate bad multitasking and ensure management (and everyone) supports the no bad multitasking policy. |
| The current environment of pushing more projects on to the Lean Resources than they can handle | Release Process Improvement projects work to the Lean Resources using a Drum Buffer Rope methodology .   |
|  |  |

#### Establish Clear priorities for Process Improvement projects

| Obstacle   | Tactical (Intermediate) Objective   |
|--|---|
| The priorities are not clear, the Lean Resources don't know whether they are working on the most important Process Improvement projects. | Devise rules and policies s that handles the requests that comes into the Lean support group. |
| There are too many interruptions, such as managers wanting their pet projects worked.  | Ensure the work rules are followed.   |
|  |   |

Pre-Requisite Tree

Super INJ Improve our processes by using tools from the Theory Of Constraints (5 focusing steps, WIP, priorities) to focus Lean resources.

INJ Use TOC 5 Focusing steps to Prioritize Process Improvement Projects

The capacity of the Lean Facilitators working Process Improvement projects is unknown

Identify constraints in current processes. Then subordinate all other Process Improvement projects.

Key Lean
Facilitators
are
overloaded

Support the Lean Facilitators working the priority Process Improvement projects

Process with constraints are not identified or managed

Lean Facilitators and Management don't know about the benefits of TOC

Train Lean Resources on TOC

Improvement projects

Limit the number of Lean Projects being worked at any time

identified and managed the priority Process

The current environment of pushing more projects on to the Lean Resources than they can handle

Release Process Improvement projects work to the Lean Resources using a Drum Buffer Rope methodology.

Bad Multitasking is allowed and even encouraged

Eliminate bad multitasking and ensure management (and everyone) supports the no bad multitasking policy.

INJ Establish Clear priorities for Process Improvement projects

There are too many interruptions, such as managers wanting their pet projects worked.

Ensure the work rules are followed.

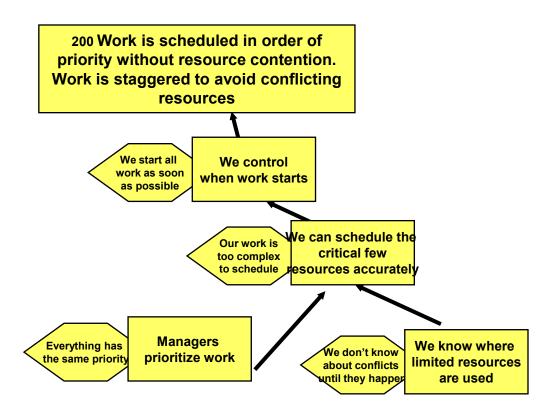
The priorities are not clear, the Lean Resources don't know whether they are working on the most important Process Improvement projects. Devise rules and policies s that handles the requests that comes into the Lean support group.

### From the PRT to the Transition Tree

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The Transition Tree CAUSES the Intermediate Objectives to exist so that the Injection will be achieved.

When all Tactical
Objectives exist, the
FRT becomes our new
Current Reality!!!!



## The Transition Tree (TT) follows a simple format to achieve: The Actions that Cause the Change

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New Reality (changed reality) is achieved.

There is a simple Five Cell Structure

Facts of life that indicate the action will be sufficient to achieve the new reality

The Need for Action (What is needed)

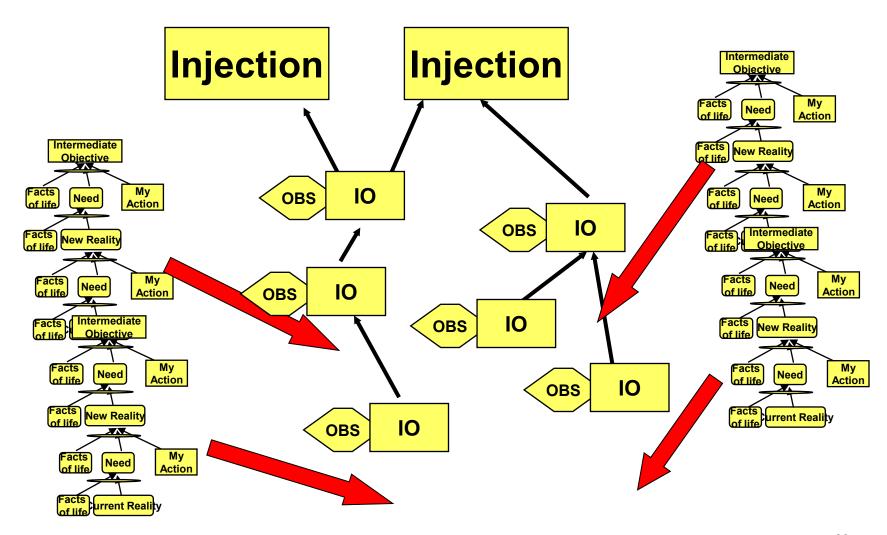
My Action (Emphasis on the action I take to cause someone (or something) to meet the need and change reality)

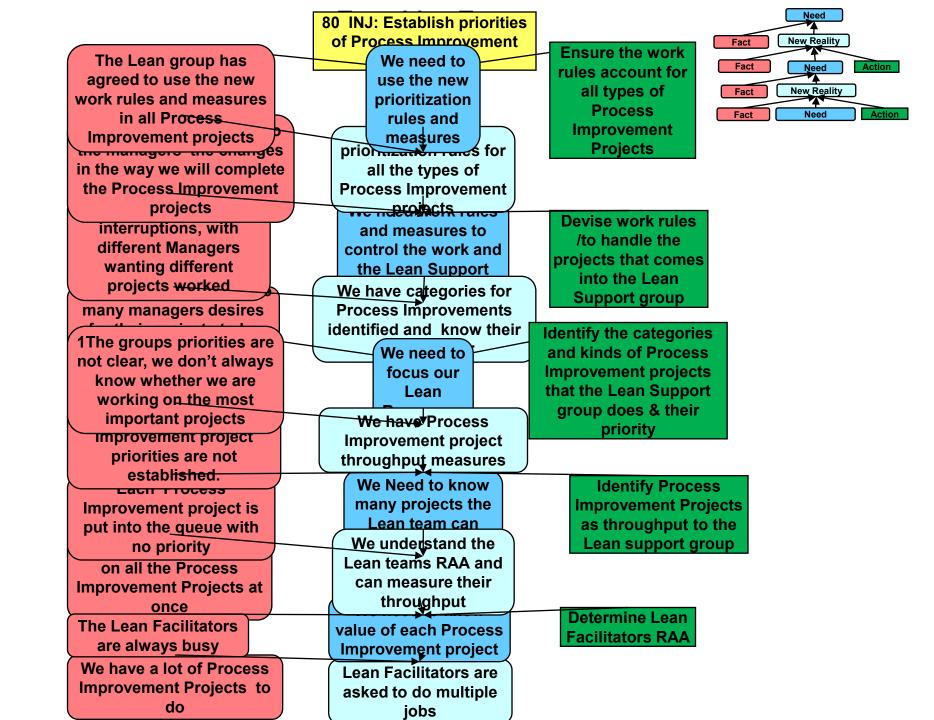
Facts associated with Current Reality that lead to the need for change.

The Current (previous)
Reality

# The Transition Tree Fills Logic <u>Below</u> and <u>Within</u> the Gap between the Intermediate Objectives of the PRT

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### Questions

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#### **Focusing Lean Support Group Core Conflict Cloud**

Story line: The company has limited resources to perform "Process Improvement" and support internal customer needs for Change and Improvement. These "change agents" are tasked with working with Employee Involvement Teams to create a culture of process improvement. There is an effort underway to explore TOC as an improvement tool.

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Combine LEAN and TOC for fast, surgical results!

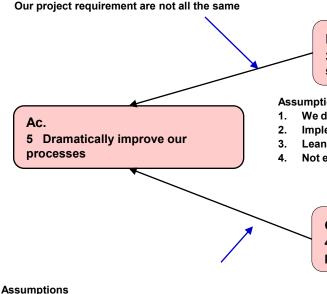
#### **Assumptions**

- 1. There is pressure to try something better than what we have been doing
- Our customer has changing requirements
- The customer wants products faster and cheaper
- Difficult to schedule today what is going to occur more than 6 months in the future

#### Train TOC folks on how they can benefit from LEAN (to improve the difficult processes they find - in CCPM for sure - and other bottleneck areas).

#### **Assumptions**

- Our current date driven scheduling causes us to have to do project rescheduling
- There is pressure to try something better than what we have been doing
- we need to improve our processes
- TOC takes in to account delays and resources availability
- TOC is a good way to create process that are adaptive



#### Bc.

3 Do things that deliver significant results quickly

#### **Assumptions**

- We don't know where to focus resources
- Implementing both concepts causes confusion
- Lean and El don't always deliver desired results
- Not everyone knows TOC

#### Dc.'

- 1. Take radical, unproven (to me), experimental procedures
- Use the Thinking Tools Process to establish priorities for Process Improvement Projects

#### Focus resources on where the highest savings are (largest improvement can be made - that contribute to Throughput immediately (or accelerate project management processes)

#### Cc.

4. Do mature, correct things that have proven to be very effective over time

#### Dc.

2. Use the best LEAN tools and techniques, El (Employee Involvement)

#### **Assumptions**

- Toyota like methods have been up to this point the company accepted method for continuous improvement.
- Toyota is considered to be successful with their implementation of Lean **Processes**
- The accepted site improvement methodology has been El
- It is easier to stay with the current culture
- El teams are easy to measure and control

Train Lean Facilitators on TOC

balanced processes (We become a fast, reliable source of expert knowledge and projects. We can pick and choose which, of many, contracts we will pursue. We are profitable. We can grow our capacity at a rate we choose.

Stable processes makes jobs easier to manage

There is a method to create and maintain stable

If we change we might create an unstable process

In order to ... **Objective** 

We need to improve our processes

We know how to control stable process

Create meaningful improvement metrics associated with Increasing Value and decreasing Time

> We need to ... Requirement

Find other ways to implement Employee Involvement (remove the obstacles to being fast and let the work itself be the reward)

In order to... We need to ... **Prerequisite** 



Track 1: CMMI and Process Improvement Session 11314, Chasm Creek 1:30-2:15 pm



# CMMI® IN THE SOCIAL MEDIA (FOR THE SOCIAL MEDIA-CHALLENGED!)

Leading Edge Process Consultants LLC www.CmmiTraining.com



Track 1: CMMI and Process Improvement Session 11314, Chasm Creek 1:30-2:15 pm



Leading Edge Process Consultants LLC www.CmmiTraining.com





### Introduction





An example of social media!

Wikipedia defines social media as

"media for social interaction, using highly accessible and scalable publishing techniques..."









### That's one definition...





### Here are a few other things social media can be...





### Introductio n



# ...time waster









This presentation focuses on how to use social media effectively and efficiently to enhance your understanding and application of the CMMI®





### We'll focus on...





facebook.

and provide a case study on using social media for customer support.





Social Media Applications

### LinkedIn







www.linkedin.com



May 2003



80 million



# 29

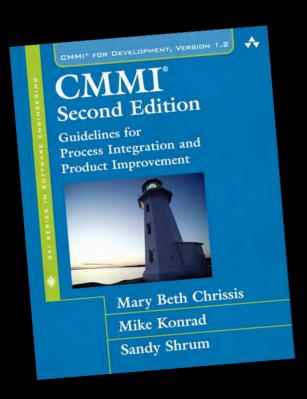


Business and professional networking









- Gathering expert opinion
  - interpretational guidance
- Staying informed
  - upcoming events
- Filling a position
  - employee, consultant, appraiser

Uh-oh... you're the SEPG Lead and your organization didn't earn their desired **Maturity Level** rating...

Finding a job!









CMMI Rocks! (Alumni Network) CMMI Diary (Blog)

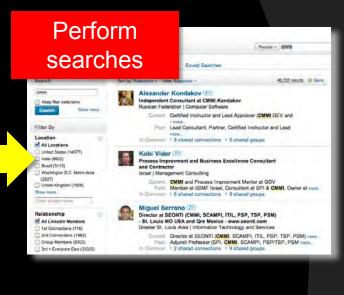
http://www.finkedin.com/in/billsmithleadingedge

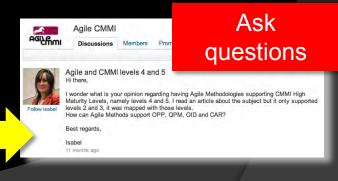




Simplified, and only focusing on a few key uses







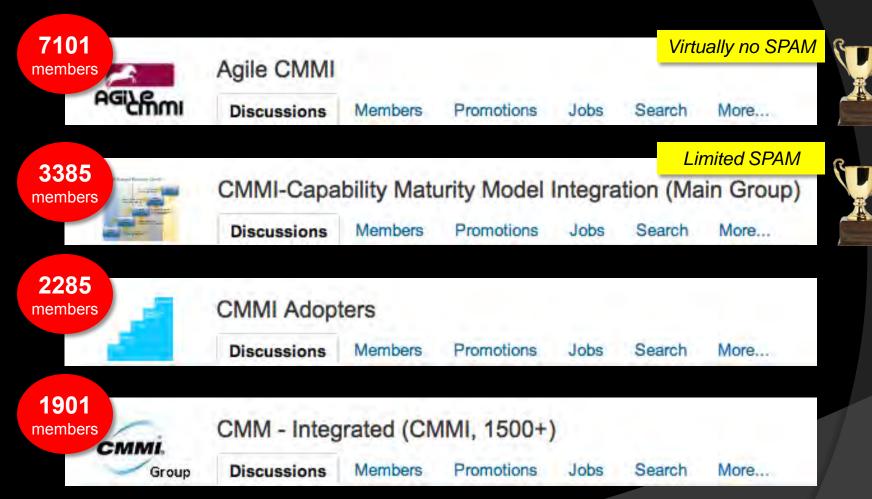
Websites

Twitter

Public Profile





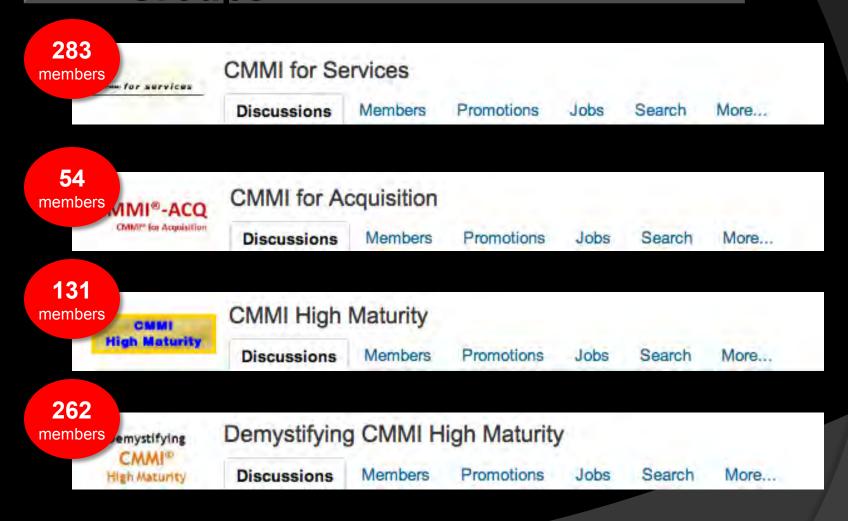


Membership totals as of 11/2/2010



# Specialized CMMI®-Related Groups





Membership totals as of 11/2/2010







National Defense Industrial Association (NDIA)

Discussions Members Promotions Jobs Search More...



SEI Membership

Discussions Members Promotions Jobs Search More...



\*

SEI Partner Network

SEI Partner Network Carnegie Mellon

Discussions

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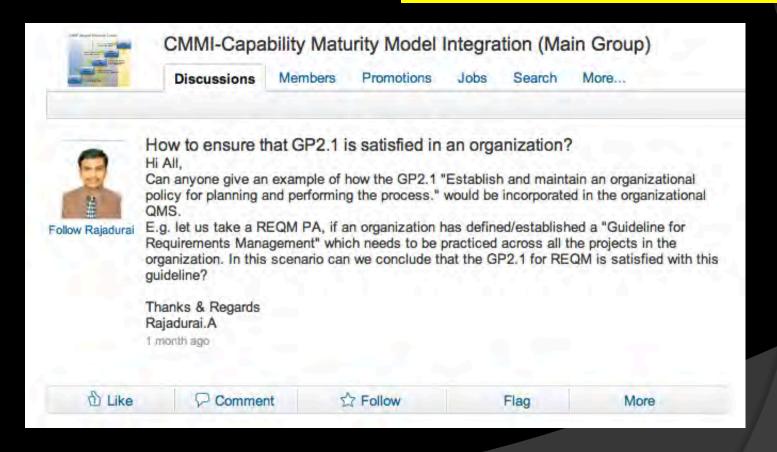
More...

Membership totals as of 11/11/2010





This question about organizational policies (CMMI® GP 2.1)...





30 comments • Jump to most recent comments

... led to a discussion thread of 30+ entries



Mathi E Arasu - Hi Raja,

Establishing a Policy conveys only an intent to perform.

However, various other GPs like 2.2, 2.3...to 2.10 and also 3.1 and 3.2 - when implemented will imply the complete implementation of GP 2.1

So, with your example, If you have a Policy for Require the implementation of this policy is planned, assigned responsibilities are defined, required training provided.

stakeholder reviewed wi process and Management

Hope this h

Cheers, Mathi Ezhil 1 month ago



Follow Rajadurai

Rajadurai Aruna implementing all t particular GP.

In my case, we've (which describes referred by the "R kind of documents define a policy sta

Need to understar

1 month ago



Follow David

David Walker • Y are no surprises, I an expectation of guildeline" in your

1 month ago



Follow Lyn

#### Lyn Jones · Rajadurai

I guess you are implementing the CMMI in order to succeeed with an Appraisal. Therefore my advise would be in support of David Walkers suggestion, ask the Appraiser, then there are no surprises. If this is not so the case then my advise would be that if you have any kind of statement from the management in regards to how they intend a specific process or set of processes to operate then take that no matter what its called and reference that as your policy statement.

My principle is if it exists, use it, far too many companies invent things unecessary in order to satisfy the "requirements" of the CMMI. This is extra work for no added value to the organisation especially when something already exists which will equally satisfy the requirement.

Another suggestion that I would recommend here is if you are either using existing or creating from new DO NOT PLEASE DO NOT make a policy statement per Process Area, too many companies do this and it is so obviously artificial and invented for the purpose, my suggestion would be to possibly have a generic Engineering Policy statement which covers all your engineering processes, maybe one Project Management Policy covering PP, PMC, IPM and maybe RSKM. Taking this approach you will end up with about 4 or 5 policy statements which are fully integrated as opposed to almost 20 disjointed policies.

Hope this helps, if you need further help email me on lyn.jones@pnltd.org.uk

Thanks

Lyn

1 month ago . Reply privately . Flag as inappropriate





From the CMMI-Capability Maturity **Model Integration** group

What is the different between: SP 2.2 Conduct Peer Reviews and SP 3.1

Perform Verification within the verification area?

posted 2 days ago

is there any one from here who can lead the course "Official Intro to CMMI"? in VN? if yes, let's contact me, Thanks

posted 4 days ago

In a recent interview I was asked to state the standard 4 strategies for implementing the CMMI. I answered this based on 15 years...

posted 1 n

Why do you need PP SP2.3 - "Plan for Data Management" when most of the things are same in CM SP 1.2 - "Establish Configuration Management... posted 2 months ago

Why Requirement Management and Requirement Development are two

differnt PA's posted 3 months ago

How to change the mindset of the people who hate process approach (other than escalation) during the process improvement journey.

posted 5 months ago





- Well-represented CMMI® community
- Free interpretational guidance from experts
- Specifically designed for business networking
- easy to use





Social Media Applications

# **Twitter**







twitter.com



July 2006



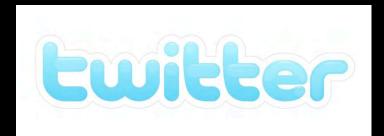
160 million



# 10

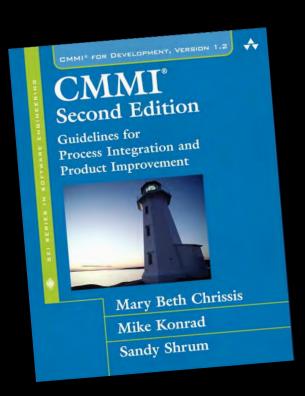


Micro-blogging









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- Gathering information
  - useful hyperlinks
- Following a conference
  - live tweeting
- Getting to know new people
  - valuable contacts

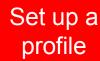
If you think the CMMI® is the best thing since sliced bread...

- Being exposed to a diversity of viewpoints
  - anti-CMMI® chatter











#### **Bill Smith** @CmmiRox Reston, Virginia, USA

CEO & CMMI Entertainer! (Huh?) Energizing trainer of 800+ people in the Software Engineering Institute's CMMI. Loves rock music, dry humor, \*real\* improvement.



## Monitor the action

I strongly recommend a twitter "client" (e.g., TweetDeck)



## People "follow" you

IT Project Mana Integration projects.



cloudjobs Cloud Computing Jobs Cloud Computing Jobs



mfalce Michele Falce SEI Technical Event Coordinator



777auditfragen PowerManager Führungsinstrument Audit



#### RogueCFO Rogue CFO Chris B.

Rogue CFO, Management Consultant. Helping growing companies by bringing outsourced CFO management talent to your team.

Simplified, and only focusing on a few key uses

nt). Amateur Video

Game business Analyst, Blogger, iPhone/iPad Game

Test Manager, Trainer, and Coach - Focusing on

Pendula IT is an offshore company, based in Chennai,

Pensioenen, PHP, fotografie, photoshop, robotica,

motoren, cradle to cradle, skaten, istab, cmmi, Almere

@ISD

You "follow"

people

developer/producer:)...

sdelesie Selena Delesie

ISDonline ISD Online

pendulait Pendula IT

People. Learning. Organizations.

India, focused on BI/DWH, BPM etc.





Track tweets of selected groups of people

Send/receive direct messages

Hope to see you in Denver Bill at

**Direct Messages** 

See when you'rementioned in a tweet

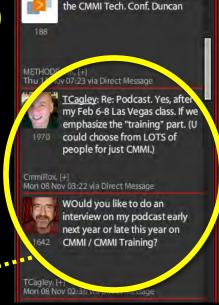
A search for all tweets including "cmmi"

> Monitor search terms





@Cmmir ווון שכטניה Are executives aware? ...most IT project managers think their job is to deliver the agreed requirements... not necessarily to deliver value #in PG\_Rule, [+] Wed 10 Nov 14:01 via HootSuite RT @guywwallace: New post -Raising the Voice of Quality - a A simple status update Is there a back button in IE for "Direct Message" (DM)conversati



Simplified, and only focusing on a few key uses

Images taken from TweetDeck

**Twitter** 

# **Example Twitter Client:**

**TweetDeck** 



Yes, I have a dedicated monitor for social media...

...but admitting you have a problem is the first step toward solving it!

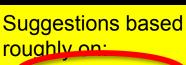
Facebook

LinkedIn









- CMMI relevance
- number o followers
- number o tweets
- number of times "listed"





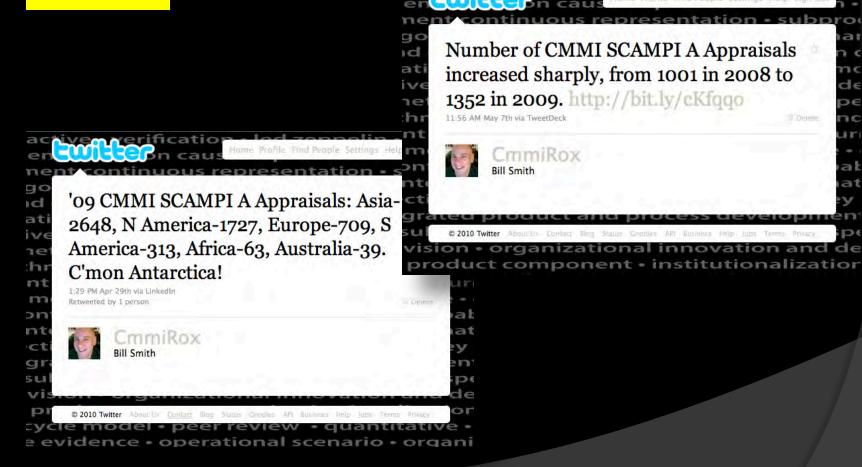








**Information** 







## **Hyperlinks**







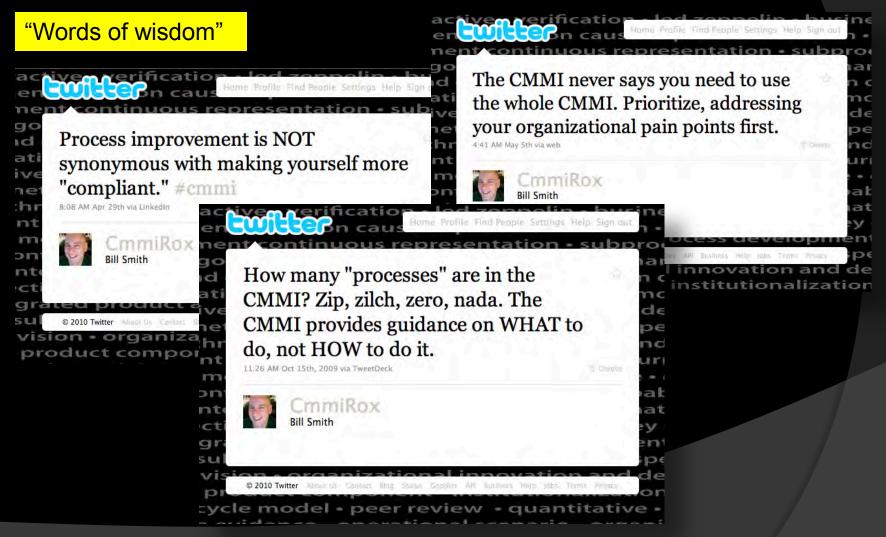
Live from conferences or other gatherings



35











General "what's happening"

Copyright 2010 Leading Edge Process Consultants LLC













- Useful hyperlinks and tidbits of information
- Get to know influential people
- Get answers from your followers
- Easy to "unfollow" people who waste your time
- Follow conferences and other events as they happen

 CMMI<sup>®</sup> community not widely represented Need to filter lots of irrelevant chatter Need third-party apps ("twitter clients") to be truly useful Not intuitive to explain or use effectively



**Social Media Applications** 

# Facebook







www.facebook.com



February 2004



500 million



2010 NDIA CMMI Technology Conf: CMMI in the Social Media...



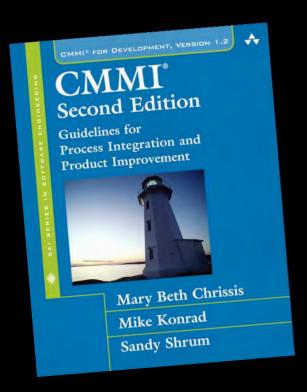
#2



Social networking







- Gathering information
  - from organizations you "like"
- Solidifying relationships
  - personal/business contacts









Set up a profile



Get status updates



Simplified, and only focusing on a few key uses





## **SEI Membership**

http://www.facebook.com/pages/SEI-Membership/147935936575



SEI Membership Don't forget the webinar on Tuesday: Are you ready for the release? What you need to know about CMMI V1.3



Calendar of Events | Calendar of Events www.sei.cmu.edu

In this webinar, Eileen Forrester will discuss the release of CMMI V1.3. All three CMMI models, CMMI for Acquisition (CMMI-ACQ), CMMI for Development (CMMI-DEV), and CMMI for Services (CMMI-SVC), will be released as technical reports on November 1. A series of other products, such as training, S

October 25 at 12:52pm · Unlike · Comment · Share

11 Friends Like This





## Leading Edge Process Consultants

http://www.facebook.com/pages/Leading-Edge-Process-Consultants/120351941356797



**An admission:** Unlike Twitter and LinkedIn, I've only been on Facebook since early October 2010. There could indeed be other disseminators of CMMI®-relevant information that I just don't know of yet. Know any? Please drop me a line.





- Some useful information
- Deepen relationships with friends
- Widely adopted
- Easy to use





Social Media Applications

# **CMMI Rocks!**





CMMI Rocks! is my network...

...that I developed from the ground up, using the social network platform Ning.

...to provide **my CMMI students** with a base level of support after class has ended.

There's no way I can be totally **objective** about it...

...and it may not directly apply to most people here.

Please accept these slides in the **spirit** in which they're intended...

A case study in how a social network may be used as part of a customer support platform







cmmirocks.ning.com



January 2010



150





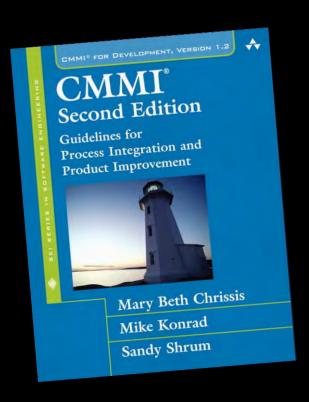
(Are you kidding me?)



Customer support and (private audience) professional networking







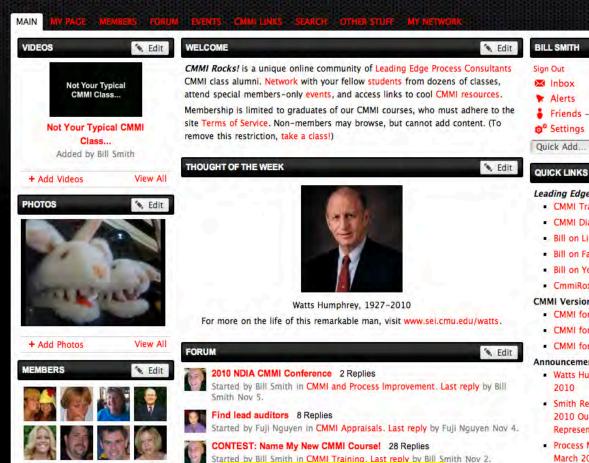
Private network, to support students who have attended one company's CMMI® classes







The Leading Edge Alumni Club



Alerts

Friends - Invite

O Settings

Quick Add...

Leading Edge Links

· CMMI Training Schedule

· Edit

CMMI Diary

Bill on LinkedIn

Bill on Facebook

Bill on YouTube

CmmiRox on Twitter

#### CMMI Version 1.3 Links

CMMI for Development

CMMI for Services

CMMI for Acquisition

#### Announcements

- Watts Humphrey, 1927-2010
- Smith Receives SEI's 2010 Outstanding Representative Award
- · Process Maturity Profile, March 2010



# Main Page -Bottom





CmmiRox: Nifty list of CMMI

CmmiRox: Welcome to my Jan. 19-

21 Intro to CMMI-DEV v1.3 class,

Solina and John from Washington

appraisal-related links:

http://bit.ly/bxHPoX

#### CMMI DIARY

#### The Top 8 New Concepts in CMMI v1.3 (Part 3)



In my past two entries (Oct 22 and Nov 1), I introduced the first seven of my *Top 8 New Concepts in CMMI v1.3* — other than the "front page news" of *high maturity clarification* and *harmonizing the models*.

Here's my Number 1.



#### 1. Agile Interpretive Guidance

Say the word "Agile." Great! Now say "CMMI." Super! Quick question: which sounds sleeker... smoother... sexier? Even the authors of the CMMI would have to admit they lose that battle every single time!

Now, I certainly can't claim to be an agile expert, based on the fact that once-upon-a-time I read a book and then I kinda-sorta applied it. (Along with a dose of the CMMI for Services, though, it did help to turn my little company around.) But I'd be a fool—and so would you—to ignore the fact that agile methods such as Scrum have taken the development

world by storm in the past decade. Yet, agile developers often don't see how CMMI can help them. Reasonable people have said it can, and publications like

#### **EVENTS**

| November 2010 |    |    |    |    |    |    |
|---------------|----|----|----|----|----|----|
| 5             | M  | T  | W  | T  | F  | S  |
|               | 1  | 2  | 3  | 4  | 5  | 6  |
| 7             | 8  | 9  | 10 | 11 | 12 | 13 |
| 14            | 15 | 16 | 17 | 18 | 19 | 20 |
| 21            | 22 | 23 | 24 | 25 | 26 | 27 |
| 28            | 29 | 30 |    |    |    |    |

Last Month Next Month

Alumni Happy Hour

December 9, 2010 from 5pm
to 7:30pm - Bill's Place

+ Add an Event View All

#### BADGE

I'm a member of: CMMI Rocks!

Get Badge





## Attend a class



## Create a profile



## Ask questions



#### Attend events



#### Access resources

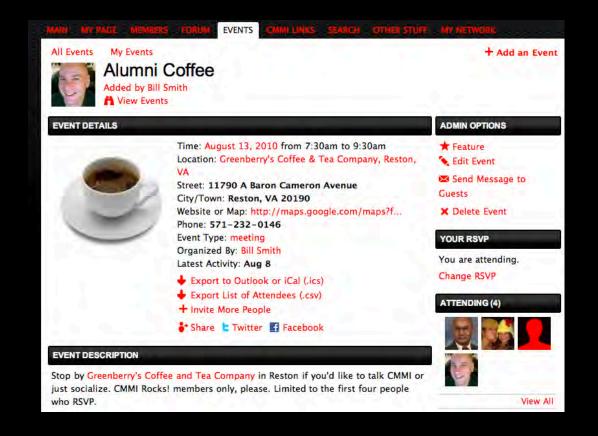
# CMMI Links Much as juan Valdez selects only the finest Columbian coffee beans, i'm handpicking the most useful CMMirelated links on the web, (Of course, I assume you already know how to get here.) As you can see, this is a work in progress; check back over the next few weeks as I develop pages for additional topics. Your friendly neighborhood CMMi instructor, Buil Smith Getting Started. You've taken my Intro to CMMI class. Congratulations! Ummm... now what? Appraisals. Determining your current state. (Advice: do it soon.) Training. It doesn't have to stop with the Intro course. Networking. Where else can you meet like-minded people? Conferences, discussion groups, SPINs, etc. Books. The books I've mentioned -- and sometimes even given away -- in class. Plus a few more.

Receive broadcast messages

Simplified, and only focusing on a few key uses











All Pages My Pages

## Class Downloads

## CMMI for Development

- CMMI Crossword. Distribute freely to your process group members. Or, use it

- How a Project Works. Amusing PowerPoint mini-presentation, adapted from

- CMMI for Services
- CMMI-SVC Quick Reference. Straight from the SEI. CMMI-SVC Summary. From Leading Edge. Crammed full of goals and pragations.
- Creatively Applying CMMI-SVC in a Very Small Consulting Firm. Our away CMMI-SVC for CMMI-DEV Enthusiasts, Another of our 2009 NDIA prese
- FERPA Form. You filled one out in class. Recapture that magical mome

Edit X Delete this Page



The SEI's CMMI Appraisals Homepage. Your official starting point, I suppose. (If I thought it was sufficient, + Add a Page

Frequently Asked Questions (FAQs). Need to understand appraisals? At the 30,000 foot level? Quickly? Then read these! They may not tell you everything you'll eventually need to know, but they will clear up common The SEI's CMMI Appraisals FAQ. Straight from the horse's mouth. Good stuff.

- An alternative CMMI appraisals FAQ. Part of the kinda-sorta famous "brutally honest, totally hip CMMIFAQ." Databases, Web-accessible SEI sites,

- Published Appraisal Results (PARS). Currently valid SCAMPI Class A appraisal results. Group or sort every-which-
- way -- by constellation, year, maturity level, etc. -- until you get bored and need to get back to your day job. • SEI Appraisal System (SAS). If and when you need to become an official Appraisal Team Member (ATM), you'll

register via this site. Until then, add this to the long list of things you don't really need to know about. Method Descriptions. Authored by the SEI, these are the official guiding documents for conducting SCAMPI

- SCAMPI A v1.2 Method Definition Document by the SCAMPI Upgrade Team. The appraisal geek's bible, containing "precise listings of required practices, parameters, and variation limits." Best left to Lead Appraisers
- or people with too much time on their hands. (You may hear this tome reverently referenced as "The MDD.") Handbook for Conducting SCAMPI B and C Appraisals. by Will Hayes, Gene Mulik, Lisa Ming, Margaret Glover, and members of the SCAMPI B and C Project. How to conduct SCAMPI B and C appraisals. (Duh!) You don't need a Lead Appraiser for these events, but you will need somebody who has had SCAMPI B and C Team Leader Books. You may find these a bit easier to read than an MDD.





# CMMI and/or SEI-related awards??

Good afternoon fellow CMMI-ers (sp?)!! I have been assigned the marvelous task of research...WOOHOO! Our CEO has asked me to search for ... Started by Danielle Bean in Success Stories



#### CMMI Version 1.2 vs. 1.3 Training Considerations

ober 24-26, 2010, Introduction to CMMI my final public v1.2 class ever. Why is this

MMI Training



# ISO Auditor Question

Since I don't Twitter and the question was raised... There are basically three levels to look at depending on what your trying

to do... ... Started by Steve May in Li



## Estimated cost for SCAMPI Class A, B, or C appraisal

Greetings, Does anyone know ROM to do class A, B or C appraisal for a software development shop? Thanks, Fuji. Started by Fuji Nguyen in CMMI Appraisals



## Process tailoring

What does useful "process tailoring guidance" look like? What is sufficiently significant to qualify as a tailoring of the Started by Rich McCabe in CMMI and Process Improvement standard process...



## Organizational Training Waivers

What standards are used to waive a student from required training? I am writing the organizational training plan and in it I need to speci...

Started by Ted H. Exstein in CMMI and Process Improvement





This question about CMMI-SVC vs. ITIL for an IT Helpdesk...

All Discussions

My Discussions

+ Add a Discussion



## CMMI-SVC or ITIL for IT helpdesk

Posted by Fuji Nguyen on May 13, 2010 at 5:52pm in CMMI for Services (Change)

Send Message A View Discussions

I went to Bill CMMI-SVC class in mid of April 2010. As usual, instructor Bill was great. I learned a lot from the class.

While listening to Bill's preaching of CMMI-SVC, I noticed many similarities between CMMI-SVC and ITIL. CMMI is broad while ITIL is specific for IT. If anyone has experiences with implementing either CMMI-SVC or ITIL in IT environment, please share. I am particularly interested in IT help desk area.

It's time to practice what we learned from Bill.

#### **ADMIN OPTIONS**

- \* Feature
- Edit Discussion
- Close Discussion
- Ldit Your Tags
- X Delete Discussion





#### Replies to This Discussion



GO Reply by Lita Fulton on May 18, 2010 at 7:26am

Send Message

Hi Fuji, I have e subset of ITIL t significant in so is the only one Function. CMM of them addres Prevention (IRP) the help desk.

As you indicate CMMI-SVC mod Delivery (SD) ar part of your set delivery (your s system (require

► Reply to This



Reply by Cathy Beykzadeh on May 18, 2010 at 6:51pm

Send Message

Fuji,

CMMI for Services is a perfect methodolo Here's a high-level approach for applying of "helpdesk" as a Service. Accordinly to by facilitating outcomes customers want risks.

Project Planning (PP): Project Plan for est support, including people, process, techn Project Monitroing and Control (PMC): Pla service establishment

Integrated Project Management (IPM): Intinitiatives on the helpdesk. for example, new locations; or modification to current Requirements Management (REQM): Manamanaging new and/or changed requirem Risk Management (RSKM): Managing you any update to current functionality or est Capacity and Availability Management (Chelpdesk establishment. for example, pla support the current phone line that the People, process, technology and product Organizational Process Definition (OPD): process assets and work environment sta Organizational Process Focus (OPF): Plan,



ee Reply by Fuji Nguyen on September 2, 2010 at 10:32am

the original questioner

Send Message

Thanks to Bill, Cathy, Lita, etc. for your guidance.

Here is my update on making help desk more Service oriented

 The term Service Desk was used to describe the functional group (instead Help Desk) [map to Organizational Process Focus (OPF)]

... led to several extensive replies,

and an eventual "report" back from

- Leveraging free open source DotNetNuke (www.dotnetnuke.com) and aDefHelpDesk (http://adefhelpdesk.com) to automate tracking of support tickets.
   Imap to Service System Development (SSD) and Service System Transition (SST)
- 3. Getting three IT staffs ITIL v3 certified [map to Organizational Training (OT)]
- 4. Updating existing help desk procedure to match ITIL v3 Service Desk function [map to Incident Resolution and Prevention (IRP)]
- Providing training to users, including a brochure of available services. [map to Service Delivery (SD)]

Attached please find the process diagram. I hope the information will be helpful to those on similar journey.

Sedit Comment

Attachments:

service\_desk\_process.pdf, 88 KB 🗶 Delete

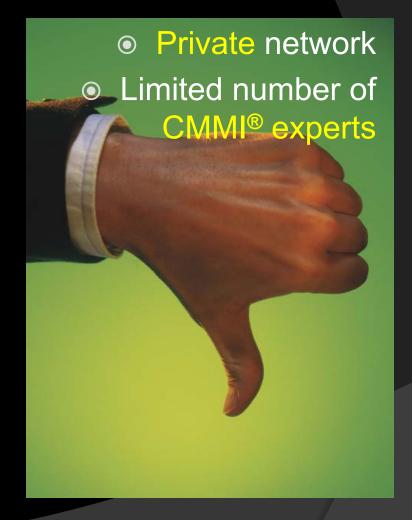
Reply to This

improvements on the helpdesk based on a thorough understanding of the current strengths and weaknesses of the organization's processes and process assets





- Logical extension of the classroom experience
- CMMI®-immersive environment
  - designed for CMMI<sup>®</sup> knowledge dissemination
- All members
   ersonally know (and presumably trust) the site owner
- Spam-free





# Summary

#### Summary



- Common social media sites include LinkedIn, Twitter, and Facebook
- Social media can used successfully for customer support (CMMI Rocks!)
- Each of these has its own unique strengths and weaknesses
- They all may be used to enhance your understanding and application of the CMMI<sup>®</sup>.

# My Other Presentations This Week



Coming up next... in this room!

10<sup>th</sup> Annual National Defense Industrial Association CMMI® Technology Conference and User Group
November 16, 2010 Denver, Colorado, USA
Track 1: CMMI and Process Improver Session 11315, Chasm Creek 2:15-3:00 pm WHAT DOESN'T KILL YOU MAKES YOU STRONGER: OCESS IMPROVEMENT LESSONS LEARNED VERSION 1.0A (LARGE FORMAT) - 10/25/2010 Leading Edge Process Consultants LLC www.CmmiTraining.com

Best Presentation, Track 1



#### Questions



# Q: Bill, why didn't you mention blogs? Or YouTube? Or other social media applications?

A: Then what would I talk about *next* year?

# Questions



Intro to CMMI v1.3 **Hard Rock Hotel** Las Vegas! Feb 8-10, 2011

#### Intro to CMMI-DEV v1.3

- Jan 19-21, 2011, Reston, VA Feb 8-10, Las Vegas, NV

Website: www.CmmiTraining.com **Blog:** www.CmmiDiary.com

**Alumni Club:** CmmiRocks.ning.com

twitter.com/CmmiRox **Twitter:** 

YouTube: www.youtube.com/CmmiRocks

www.linkedin.com/in/billsmithleadingedge LinkedIn:

Facebook: www.facebook.com/pages/

> Leading-Edge-Proces s-Consultants/

120351941356797





bill@cmmitraining.com

Bill Smith

10<sup>th</sup> Annual National Defense Industrial Association CMMI<sup>®</sup> Technology Conference and User Group

November 16, 2010

Denver, Colorado, USA

Track 1: CMMI and Process Improvement Session 11315, Chasm Creek 2:15-3:00 pm Best Presentation, Track 1





# MY PROCESS IMPROVEMENT LESSONS

### LEARNED

**VERSION 1.0A (LARGE FORMAT) – 10/25/2010** 

Bill Smith, CEO

Leading Edge Process Consultants LLC www.CmmiTraining.com





10<sup>th</sup> Annual National Defense Industrial Association CMMI® Technology Conference and User Group

November 16, 2010

Denver, Colorado, USA

Track 1: CMMI and Process Improvement Session 11315, Chasm Creek 2:15-3:00 pm Presentation.





WHAT DOESN'T KILL YOU MAKES YOU **STRONGER:** 

**MY PROCESS** IMPROVEMENT LESSONS

VERSION 1.0A (LARGE FORMAT) - 10/25/2010

Bill Smith, CEO

Leading Edge Process Consultants LLC www.CmmiTraining.com





### No, that wasn't me. I have 0 tattoos...

...that I'll admit to.

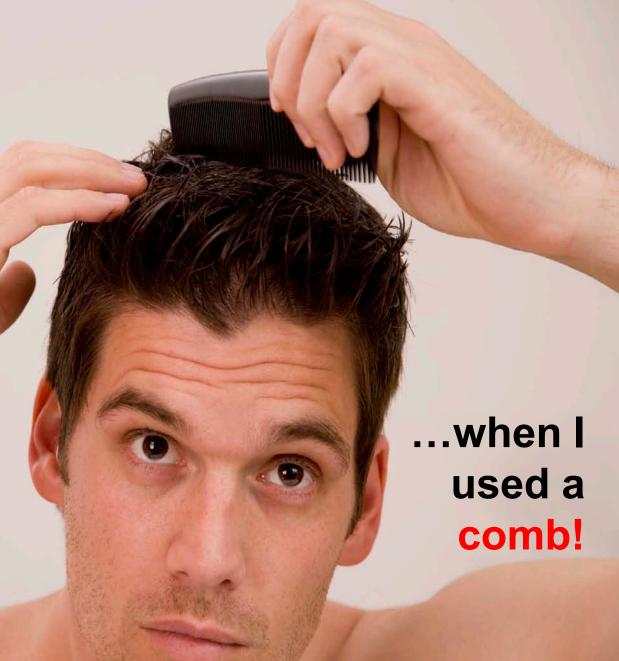
2010 NDIA CMMI Technology Conference: What Doesn't Kill You...



### Introduction

### Introductio n

I've been involved in improvement initiatives dating all the way back to...







One theme has emerged...

# Introductio

# "Out of life's school of war: What does not destroy me, makes me stronger."

Friedrich Nietzsche, 1889. Often paraphrased as "What doesn't kill you makes you stronger."





Or
to put a
more modern,
less depressing
spin on it...

### Introductio n

"Next time you feel like
It's just one of those days
When you just can't seem to win
If things don't turn out the way you
planned
Figure something else out
Don't stay down, try again, yeah...

Everybody makes mistakes, Everybody has those days...

Nobody's perfect!

"Hannah Montana aka Miley Cyrus on the stage of Hannah Montana Tour," Author: Mike Schmid from Hollywood CA. Photo in public domain, used here under the following license: http://creativecommons.org/licenses/by-sa/2.0/

Hannah Montana "Nobody's Perfect" 2007





So that you can avoid some of the mistakes l've seen and sometimes even made...





### I submit to you my...







#### Background

- Organization: ML 1, new to measurement except for the basics (e.g., cost)
- Me: Newly appointed PI consultant, in my first SEPG meeting w/ them...







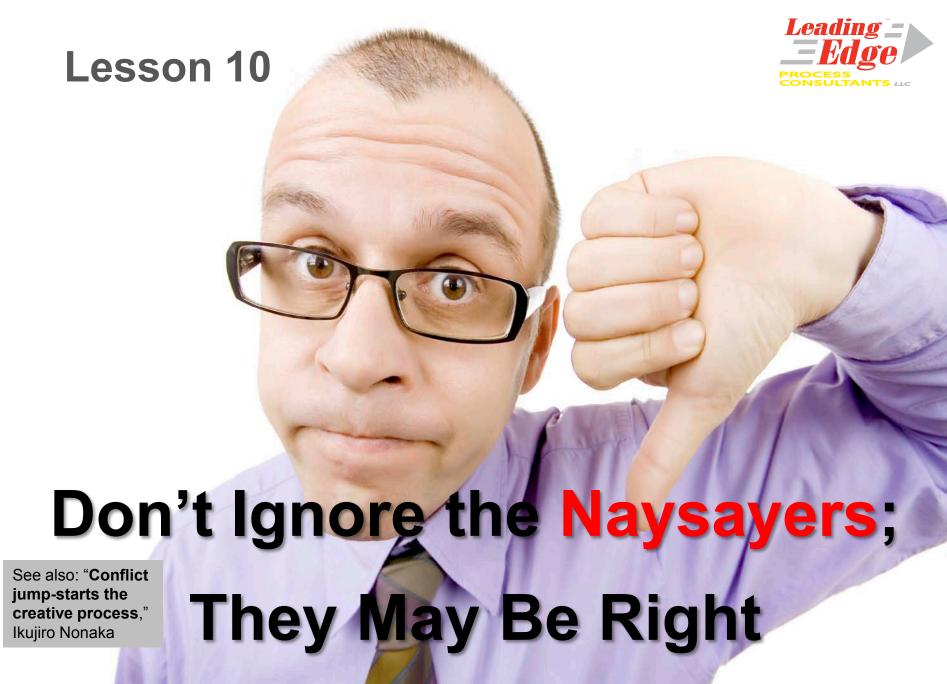
Everyone agrees, except one guy (a PM) saying "no way"



Vote called, measures "adopted"

# Results

- Six months planning / trying to collect the measures
- All but 2 are eventually abandoned
- Frustration among projects, wasted time and









#### **Notes**

That project manager was the voice of reality!

- ☐ Value alternative
- perspectives
- ☐ Don't "steamroll";
- strive for consensus
- Satisfy the WIFM for key stakeholders

("What's In it For Me")

# Don't Ignore the Naysayers;

See also: "Conflict jump-starts the creative process," Ikujiro Nonaka

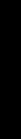
They May Be Right





#### Backgroun d

- Me: Tech lead of an 8-person software development team
- Team: Recently started code reviews, everyone's OK with them except...



Events



One guy
takes them
personally,
always
pushing back
until 1 day...



He sits
quietly
through a
review of his
code... a
good sign (?)



Immediately afterwards, he repeatedly pounds a refrigerator against the wall in frustration!

Results

• Three weeks later, he leaves the company... on his own (presumably taking a job in an organization where they don't do code reviews!)

1



You May Lose People... and That's Okay



#### **Notes**

Despite our best efforts, we lost a valuable employee; maybe we were all better off

- ☐ Remember the WIFM (Lesson 10), be empathetic, and use every ounce of your people skills
  - ☐ But... don't be too hard on yourself when someone just won't "get with the program"

# You May Lose People... and That's Okay





#### Background

- Organization: Assorted ones, with varying degrees of guilt
- Me: A (youthful) software developer



I'm told we have processes, and I'm handed some impressive binders



I put the binders on my bookshelf, intending to look at them "when I have time"



I keep doing what I was doing, the way I've always done

#### I'm not trained in the processes

- Nobody seems to care if I use them
- "Has anyone actually tried these?"
- My bookshelf under the weight of the binders

Results





"And Then a Miracle Happens"...

See also: "Train, train, train," Watts Humphrey

...ls *Not* a **Deployment Plan** 



#### **Notes**

- ☐ Pilot!
- ☐ Train!
- ☐ Enforce! (Even better:
- care!)
- ☐ Consider projects' existing commitments
- ☐ Honor "legacy projects": Is business value enough to justify

change?

"And Then a Miracle Happens"...



See also: "Train, train, train," Watts Humphrey

...Is Not a **Deployment Plan** 





#### Background

- Organization: (The less said, the better)
- Me: (I plead "the Fifth")



Organization believes they must be "compliant" *now!* -- to compete



They develop & deploy process descriptions as fast as humanly possible



Eventually, leading up to an appraisal

#### Successful ML 3 Level rating!

- Several months later, I hear from a POC that they're not doing that "CMMI® stuff" anymore
- Back to be as usua (Until the next

appraisal?)

Events

Results



**Process Improvement** and Compliance **Are Not** 

See also: "Cynicism and dysfunction both begin when managers start saying one thing and thinking another," Roger Martin

Synonymous

**Are Not** 



**Process Improvement** and Compliance

See also: "Cynicism and dysfunction both begin when managers start saying one thing and thinking another," Roger Martin

Synonymous

#### **Notes**

- Doing process improvement fast can equal doing it wrong
- ☐ Avoid "crappy" CMMI®-compliant processes
- ☐ Survival of the fittest: If your processes don't make things better, cheaper, or faster... they won't (& shouldn't) last





#### Background

- Organization: ML1, striving for (and will eventually attain) ML 3
- Me: Their process improvement consultant

# Events



One PM has team meetings

...every

...single

...day!



I suspect overkill, and I'm secretly glad I don't work for that guy



Gradually, I learn more...

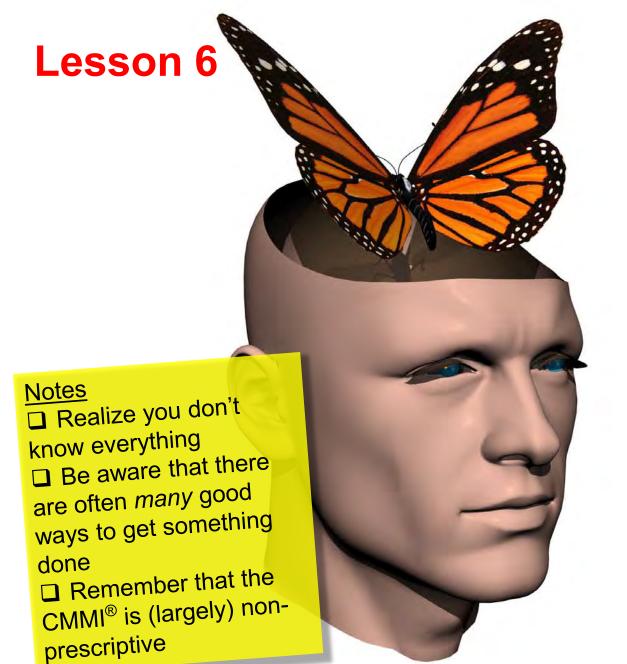
Results

- His project is the only 1 in the org to reliably deliver software on-time
- His customer & team love him
- He's using Scrum, an agile method
- Overkill? No. Potential best practice? Yes!





See also: "Keep an open mind and a level head," Watts Humphrey





## Keep an **Open** Mind

# Keep an

See also: "Keep an open mind and a level head," Watts Humphrey





#### Background

- Team: Three-person IV&V team, has been operating for about six weeks
- Me: Their new team lead



Team member has been working full-time on an "IV&V database"

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But he hasn't actually been doing IV&V, & the database is constantly being redesigned!



I pull the plug on the database development

# Results

- We start focusing on our ob – to do IV&V instead of building a money-sucking software application
- We begin using a spreadsheet, which suits us just fine for the next year









#### Background

- Organization: Small consulting company, simply interested in getting better
- Me: Quality Manager, tasked to begin a PI effort with little funding







We spend weeks developing our "process for developing a process"



It's great!

Results

- \$ pressures ("billability") torpedo the effort
- Created assets that are super in theory, but never actually help the business
- Time, mor

## Leading Edge Lesson 4 Avoid a **One-Size-Fits-All** Improvement **Approach** See also: "You have choices in your improvement approach," Suzanne Garcia, Richard Turner w.CmmiTraining.com 2010 NDIA CMMI Technology Conference: What Doesn't Kill You... Copyright 2010 Leading Edge Process Consultants LLC



#### **Notes**

I was doing PI the way
I'd seen it done in large
corporations

- ☐ Big company approaches may not work in small companies
- IDEAL<sup>SM</sup> may not always be ideal.
  Consider other approaches (e.g. DLI Decision-Based Life Cycle for Improvement,

CMMI® Survival Guide)

Avoid a
One-Size-Fits-All
Improvement
Approach

See also: "You have choices in your improvement approach," Suzanne Garcia, Richard Turner

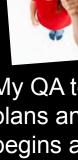




#### Background

See also: Lesson 2

- Organization: Recently formed 80-person software development organization
- Me: Newly appointed Quality Assurance Manager





My QA team plans and begins a series of audits



No projects are following the organizational standard process!



We try to find out "Why?"

Results

- Developers are not undisciplined or lazy or in need of training
- The organization's processes are(verifiably) bad!



If People
Aren't
Following
Your
Process,
Ask

See also: "To identify actions that address a defect or problem, you need to understand its root causes," CMMI-DEV v1.2 (CAR)



If People
Aren't
Following
Your
Process,
Ask

#### **Notes**

- Don't assume your processes are being ignored because people are lazy, untrained, etc.
- People may simply be trying to do a good job, by avoiding your bad processes!
- ☐ Use elements of CAR, even at low maturity

See also: "To identify actions that address a defect or problem, you need to understand its root causes," CMMI-DEV v1.2 (CAR)





#### Background

See also: Lesson 3

- Organization: Recently formed 80-person software development organization
- Me: Newly appointed Quality Assurance Manager



Going back to Lesson 3: Why did the organization develop "bad" processes?



They'd formed a tiger team that labored for 6 weeks



The team included nobody that would be using the processes!

Results

- You already know that: The processes were unusable!
- A process redevelopment effort began...
- ...but after several months, the organization the contract due to poor performance



Involve the Right People

See also: "Ultimately, everyone must be involved," Watts Humphrey



Involve the Right People

See also: "Ultimately, everyone must be involved," Watts Humphrey

#### **Notes**

Now I cringe in fear when I hear "tiger team"

- Avoid stacking your EPG with "ivory tower" experts
- ☐ Involve people who will be responsible for executing the processes
- Include a diversity of perspectives; you'll end up with better stuff!





#### Background

- Organization: Small company, nearly ML2, moving towards ML 3
- Me: Their PI consultant



PI effort way behind schedule



We draw a fishbone diagram, identify root causes, implement solutions



Most solutions involve treating PI like a real project

- We rigorously estimate process development time
- We develop a schedule down to the short-duration task level
- We track actual progress in detail
- Successful ML3 appraisal - on time!

Results



#### Notes.

- ☐ Make PI your most important project, or it'll never compete with short-term customer demands
  - ☐ Consider every practice from PP and PMC for your PI initiative
  - ☐ Estimate like a pro, instead of pulling numbers out of...

See also: "Unplanned process improvement is wishful thinking," Watts Humphrey





## Summary

#### Review



- 10. Don't Ignore the Naysayers; They May Be Right
- 9. You May Lose People... and That's Okay
- 8. "And Then a Miracle Happens" Is Not a Deployment Plan
- 7. Process Improvement and Compliance Are Not Synonymous
- 6. Keep an Open Mind



#### References



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- Garcia, Suzanne, and Turner, Richard. CMMI<sup>®</sup> Survival Guide: Just Enough Process Improvement. (Boston: Addison-Wesley, 2007).
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- Senge, Peter, et al. The Dance of Change: The Challenges to Sustaining Momentum in Learning Organizations. (New York: Doubleday 1999).

# My Other Presentations This Week



...I hope you were able to make it!



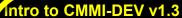




Bill Smith

bill@cmmitraining.com

Intro to CMMI v1.3 **Hard Rock Hotel** Las Vegas! Feb 8-10, 2011



- Jan 19-21, 2011, Reston, VA Feb 8-10, Las Vegas, NV

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# NDIA CMMI Technology Conference and User Group

# NASA Experience with CMM and CMMI

November, 2010

John C. Kelly & Tim Crumbley

Office of Chief Engineer



## NASA Experience with CMM and CMMI

#### Outline

- NASA's experience with CMMI model
- NASA's CMMI requirement
- NASA's lessons learned and key impacts from using CMMI



Atop twin columns of fire, space shuttle Atlantis roars into the cloudy sky above Launch Pad 39A at NASA's Kennedy Space Center in Florida on the STS-125 mission.

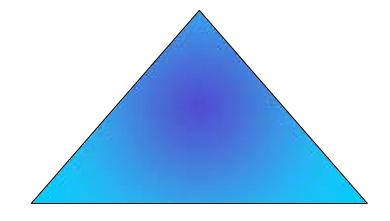


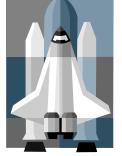
## The Three Elements of Project Success

Process: a defined method involving steps or operations



People: Skills, Training, Management

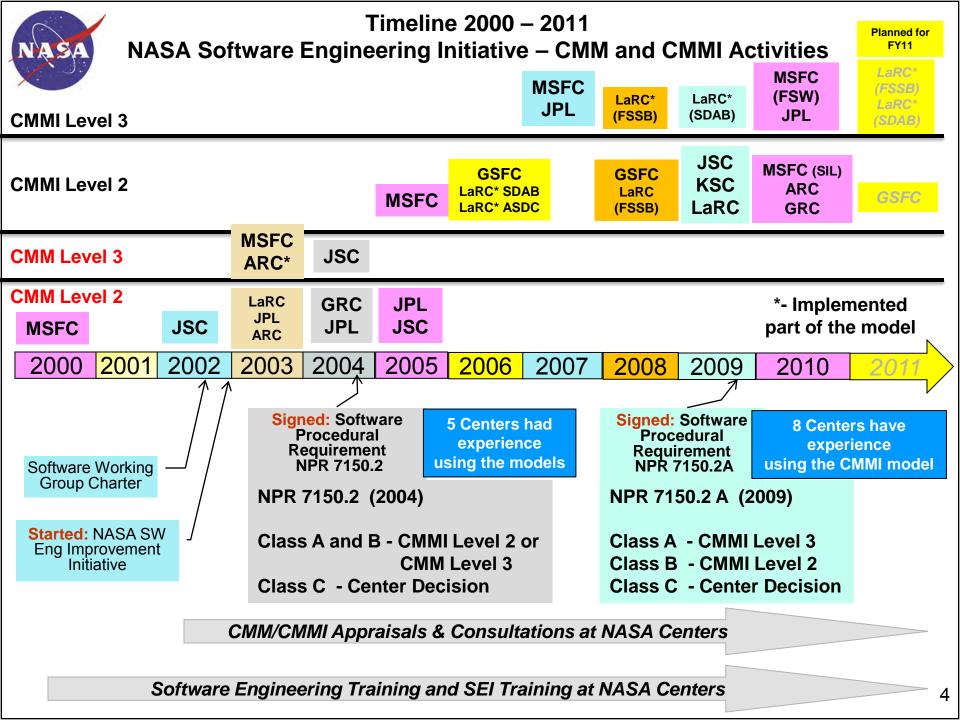




Technology:
Application domains,
tools, languages,
information, environments

Improved Process + Competent Workforce + Appropriate Technology

Reduced Risk, Higher Productivity, and Better Quality





## NASA CMMI Summary Completed SW Engineering Appraisals from FY07-FY10

|                       | CMMI = Capability Maturity Model Integrated (Carnegie Mellon University – SW Engineering Institute) |           |               |                              |                        |                              |
|-----------------------|---|-----------|---------------|------------------------------|------------------------|------------------------------|
| Center/Organization   | Rating (SCAMPI A by Certified Appraiser)  | Date      | #<br>Projects | Туре                         | Organizational<br>size | Software Classes<br>Assessed |
| LaRC- ASDC            | PP(CL3), CM(CL1)  | Nov-06    | 1             | Data Center Support          | 85                     | Class C                      |
| MSFC                  | ML3   | Apr-07    | 3             | Development                  | 63                     | Class A, B and C             |
| JPL                   | ML3   | Sep-07    | 7             | Dev & Maintenance            | 1000                   | Class A, B and C             |
| GSFC                  | ML2 + RSKM(2)   | May-08    | 4             | Dev & Maintenance            | 600                    | Class A, B and C             |
| LaRC- FSSB            | ML2 + CL3   | Oct-08    | 3             | Services                     | 5                      | Class B & C                  |
| LaRC- SDAB            | PP(CL3), REQM(CL3),<br>CM(CL3), MA(CL3)   | Mar-09    | 4             | Development                  | 21                     | Class B & C                  |
| JSC                   | ML2   | Apr-09    | 4             | Development                  | 90                     | Class A, B, C and D          |
| KSC                   | ML2   | Sep-09    | 1             | Development                  | 225                    | Class A, B and C             |
| MSFC - SIL            | ML2 + CL3   | May-2010  | 1             | Development                  | 50                     | Class C                      |
| ARC –ISD<br>(Code TI) | ML2   | May-2010  | 6             | Development                  | 63                     | Class B & C                  |
| GRC-Flt SW            | ML2   | Aug 2010  | 2             | Development                  | 22                     | Class C & D                  |
| MSFC-FIt SW           | ML3   | Aug 2010  | 1             | Development                  | 75                     | Class A                      |
| JPL – Mission SW      | ML3   | Sept 2010 | 9             | Development &<br>Maintenance | 950                    | Class B and C                |
|                       |   |           |               |                              |                        | •                            |



#### **Sample of NASA Industry Partner Ratings**

| NASA Projects  | Industry Partners   | CMMI<br>Level |
|--|---|---------------|
| Shuttle Primary Avionics Software System (PASS), Shuttle SAIL test facility, Orion Crew Exploration Vehicle (Orion)    | United Space Alliance Flight Software Element (FSWE)        | Level 5       |
| International Space Station (C&DH), Ares   | Boeing  | Level 3       |
| Orion Crew Exploration Vehicle (Orion)   | Lockheed Martin Corporation                                 | Level 3       |
| Orion Crew Exploration Vehicle (Orion), Ares   | Honeywell   | Level 3       |
| Orion Crew Exploration Vehicle (Orion)   | ATK   | Level 3       |
| Ares   | Draper  | Level 3       |
| Ares J-2X, Orion Crew Exploration Vehicle (Orion), Space Shuttle Main Engine   | Hamilton Sundstrand Rocketdyne / Pratt & Whitney Rocketdyne | Level 3       |
| Ares, Deep Impact 1  | Ball  | Level 3       |
| James Webb Space Telescope   | Northrop Grumman  | Level 3       |
| GRAIL, Juno  | Lockheed-Martin Space and Exploration Systems               | Level 3       |
| Ground Systems Engineering (GSE) Checkout, Assembly and Payload Processing Services (CAPPS) Kennedy Space Center (KSC) | Boeing  | Level 3       |
| ISS Environmental Control and Life Support Systems, Orion Crew Exploration Vehicle (Orion)                             | Hamilton Sundstrand   | Level 3       |
| GOES-R   | Harris IT Services Corporation                              | Level 3       |
| MSFC Engineering Support Contractor  | Jacobs Engineering  | Level 3       |
| STEREO   | Johns Hopkins University Applied Physics Laboratory         | Level 3       |
| NASA Software IV&V Services, JSC Support Contractor  | L-3 STRATIS   | Level 3       |
| KSC Support\Shuttle support  | United Space Alliance, LLC                                  | Level 3       |
| NASA Aircraft Management Information System (NAMIS) software   | SAIC, Aircraft Operations Support System (AOSS)             | Level 3       |
| JSC Support Contractor   | Tietronix   | Level 2       |

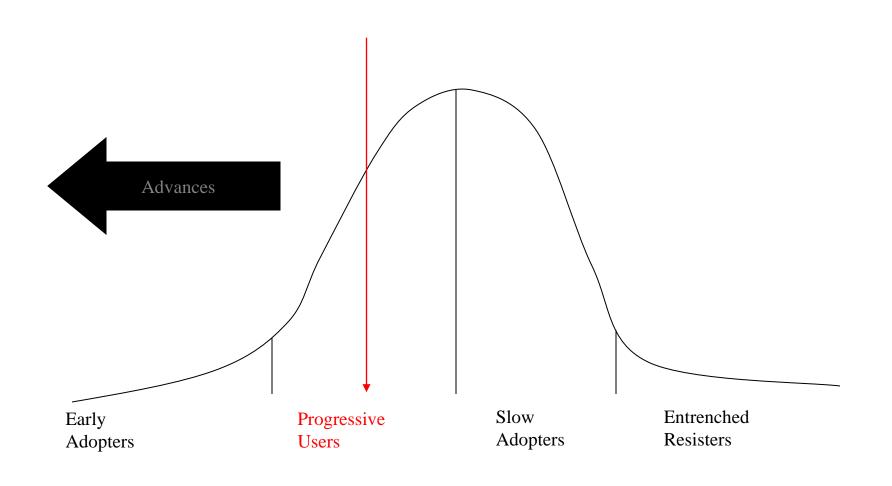


#### **NASA's Software Engineering Requirements**

- Software engineering is a <u>core capability and a key enabling technology</u> for NASA's missions and supporting infrastructure.
- The NASA Software Engineering Procedural Requirements (NPR 7150.2A) supports the implementation of the <u>NASA Policy Directive (NPD) 7120.4</u>, <u>NASA Engineering and Program/Project Management Policy</u>.
- The NASA Software Engineering Requirements provide a minimal set of requirements established by the Agency for software acquisition, development, maintenance, retirement, operations, and management.
- The NASA Software Engineering Requirements are intended to support NASA programs and projects to accomplish their planned goals (e.g., mission success, safety, schedule, and budget) while satisfying their specified requirements.
- The NASA Software Engineering Requirements provide a <u>set of software</u> <u>engineering requirements in generic terms</u> to be applied throughout NASA and its contractor community.

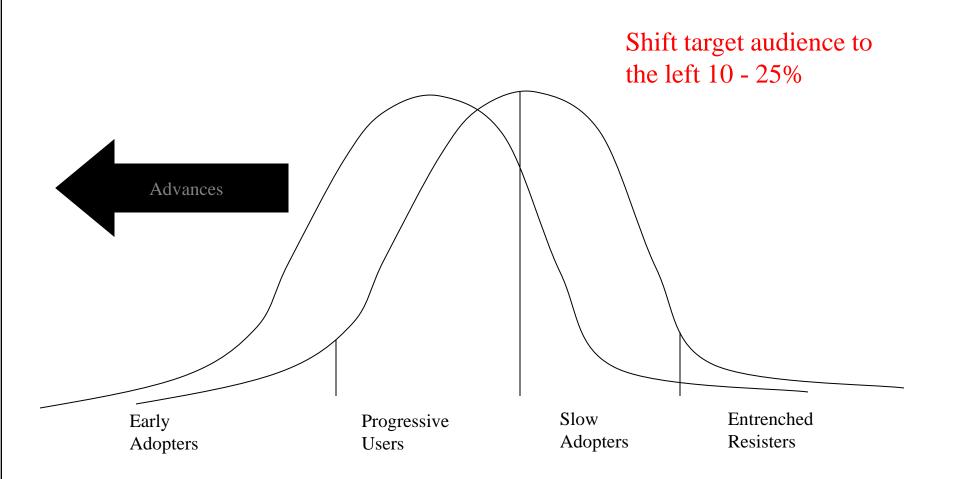


#### **Profile of NPR target audience**





#### **Purpose of NPRs**



This is our target after putting the NPR in place and after each NPR update cycle



#### **NASA-wide Software Classification\***

Class A Space Flight Human Rated Software Systems

Class B Non-Human Space Rated Software Systems

Class C Mission Support Software & Facilities

Class D Analysis and Distribution Software

Class E Development Support Software

(e.g., Class A – C is mostly software developed or acquired for Highly Specialized IT systems)

Class F General Purpose Computing Software

(Multi-Center or Multi-Program/Project)

Class G General Purpose Computing Software

(Single Center or Project)

Class H General Purpose Desktop Software



# NASA Software Engineering Requirements, NPR 7150.2 CMMI Requirement

- [SWE-032] The project shall ensure that software is acquired, developed and maintained by an organization with a non-expired Capability Maturity Model Integration® for Development (CMMI-DEV) rating as measured by a Software Engineering Institute (SEI) authorized or certified lead appraiser as follows:
  - For Class A software: CMMI-DEV Maturity Level 3 Rating or higher for software, or CMMI-DEV Capability Level 3 Rating or higher in all CMMI-DEV Maturity Level 2 and Maturity Level 3 process areas for software.
  - For Class B software: CMMI-DEV Maturity Level 2 Rating or higher for software, or CMMI-DEV Capability Level 2 Rating or higher for software in the following process areas:
    - a. Requirements Management.
    - b. Configuration Management.
    - c. Process and Product Quality Assurance.
    - d. Measurement and Analysis.
    - e. Project Planning.
    - f. Project Monitoring and Control.
    - g. Supplier Agreement Management (if applicable).
  - For Class C software: The required CMMI-DEV Maturity Level for Class C software will be defined per Center or project requirements.



#### **CMMI** Requirement Notes

- Note: Organizations who have completed Standard CMMI® Appraisal Method for Process Improvement (SCAMPISM) Class A appraisals against the CMMI-DEV Model are to maintain their rating and have their results posted on the SEI web site so that NASA can assess the current maturity/capability rating. Software development organizations need to be reappraised and keep an active appraisal rating posted on the SEI web site during the time that they are responsible for the development and maintenance of the software.
- Note: For Class A software development only, a transition period to obtain a CMMI-DEV Maturity/Capability Level 3 Rating will be allowed for organizations developing Class A software per the NASA Headquarters Office of the Chief Engineer approved Center Software Engineering Improvement Plan as described in SWE-003, SWE-004, and SWE-108.
- Note: For Class B software, in lieu of a CMMI rating by a development organization, the project will conduct an evaluation, performed by a qualified evaluator selected by the Center Engineering Technical Authority, of the seven process areas listed in SWE-032 and mitigate any risk, if deficient. This exception is intended to be used in those cases in which NASA wishes to purchase a product from the "best of class provider", but the best of class provider does not have the required CMMI rating. When this exception is exercised, the Center Engineering Technical Authority should be notified.



#### **CMM/CMMI** Lessons Learned by NASA

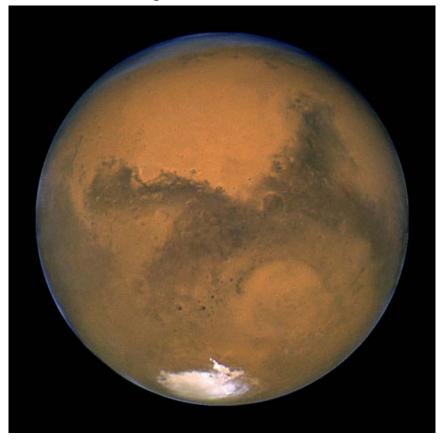
- Preparing for an appraisal is where you get the measurable process improvement
- CMMI process helped Centers establish a baseline of where they are
- Develop an extensive set of "tools" (i.e., templates, spreadsheets) to help projects with CMMI practices and artifacts
  - Use of toolset helped projects reach compliance much faster
- Mentors can help get Project tool use started and help Projects tailor the artifacts
- Established sponsorship across departments
  - Management Steering Group
  - Was difficult to get mid-level managers to "own" improvement program
- Established early on a relationship with the Lead Appraiser
- PIID development and artifact collection
  - PIIDs and artifacts were maintained on a server for ease of access and review
- Importance of interview preparation and training



The perfectly picturesque spiral galaxy known as Messier 81, or M81

#### **CMM/CMMI** Lessons Learned by NASA

- Use the workshops to review the processes in depth and reinforced the tool sets
- Tracking Progress, determine a method for projects to report progress
- Many of our projects need basic project management and configuration management training
- CMMI assessments helped identify areas for process and project improvement
- Despite initial reluctance, pre-appraisal was a positive experience for our projects - laid a good foundation for future involvement
- Projects appreciated systematic and analytical feedback on what they are doing
- Measurement and analysis is a big challenge
- Improved quality and review of management plan early in the life cycle and reuse of the plans for new projects
- Resource planning and tracking at the individual process level provided little additional benefit to the projects
- Smaller projects need to have light-weight processes to avoid being smothered (especially for a one person task)



Mars
Image Credit: NASA/JPL-Caltech



#### **CMMI Key Impacts at NASA**



Space Shuttle Launch picture from Disney's Castle

- Reduces risk of software failure Increases mission safety
  - Improvement processes based on best practices in Industry and Government
  - Risk management much improved on software subsystems--Previously there was little monitoring of risks
- More predictable software cost estimates and delivery schedules
  - Data showed projects working within CMMI software framework & best practices had increased accuracy in cost estimates and smaller growth in resources over the lifecycle
- Smarter buyer of contracted out software
  - Educating the NASA workforce on best practices in Software Engineering
- More defects found and removed earlier
- Reduces duplication of efforts between projects
- Increases ability to meet the challenges of evolving software technology
- Software development planning has been improved across the Agency
  - There is a growing consensus among the practitioners and software managers that working to a defined process has substantial benefits.
  - Vast improvement in planning of software projects and in monitoring progress
- NASA's contractor community has heard the word that the bar has been raised with respect to software engineering and is responding appropriately
  - NPR 7150.2A, Software Engineering Requirements (update Nov 2009)



#### **CMMI Key Impacts at NASA**

#### A solid foundation and structure is now in place for developing software in a disciplined manner

- More uniformity in management plans, reviews, test plans, status reporting Risk management much improved on software subsystems--Previously there was little monitoring of risks
- Data management and configuration management has improved
- Improve the working relationships between Engineering and Safety and Mission Assurance with respect to software engineering

#### The Agency is better prepared for major programs and projects than it was 8 years ago

- Software teams and software quality engineers are working together to assure compliance to standards, to improve quality
- The knowledge and skills of the NASA software engineering community has significantly improved
  - We have seen significant cultural changes.
- Extensive mentoring program established to improve software practices
- Our projects are now better managed –
  particularly in the area of progress tracking
  - Now we know exactly where we are in the project and how long it's likely to take to finish



Space Shuttle Atlantis Rollout at Kennedy Space Center April 2010



# Summary of NASA's Experience with CMM and CMMI

Why improve processes? Because process is the foundation for all other improvements, and lasting improvements are not possible without it.

If a performance management system is not in use, leadership is unaware of what is and is not working.

CMMI is a proven approach to performance management – with more than a decade of results showing

it does work.

Simply deciding to "do CMMI" is not enough to achieve benefits.

Defining good processes, using them, measuring the results, and making improvements based on what you learn are all key to reaping the benefits of process improvement.

The CMMI models are one part of a comprehensive approach to process improvement that helps organizations understand

- why they should improve
- what frameworks and tools would best fit their needs
- how to implement them



Apollo 8, the first manned mission to the moon

# **Configuration Management**

2010 NDIA SEI CMMI Conference Denver, Colorado

て。 Al Florence

This presenter's affiliation with the MITRE Corporation is provided for identification purposes only and is not intended to convey or imply MITRE's concurrence with or support for the positions, opinions or view points expressed by this presenter.



#### **Presentation Contents**



- Reasons for Configuration Management (CM)
- CM Concepts
- Formal CM
  - Formal Baselines and Configuration Items (CIs)
  - Configuration Control Boards (CCBs)
    - Supported with Technical Review Boards (TRBs)
  - Change Control
  - CM Audits and Status Accounting
- Internal CM
  - Internal Baselines
  - CM of Design, Code, Hardware Items, Test Articles
- Operation CM
  - During Operation / Maintenance
- References



# Why CM?

- CM ensures that the current configuration of items are known throughout their lifecycle
- CM ensures that changes to the configuration of evolving items are correct, controlled, managed, and documented
- CM helps manage complexity, interface dependencies, increases security, and recovery from errors

#### What is CM?

- CM is a discipline applying technical and administrative direction and surveillance to:
  - Identifying and documenting the physical, functional, and performance characteristics of items
  - Baselining those characteristics
  - Controlling changes to those characteristic
  - Providing status on those characteristics
  - Conducting audits on those characteristics
- The CM tasks that produce these results are:
  - Configuration Planning
  - Configuration Identification
  - Configuration Control
  - Configuration Status Accounting
  - Configuration Management Audits



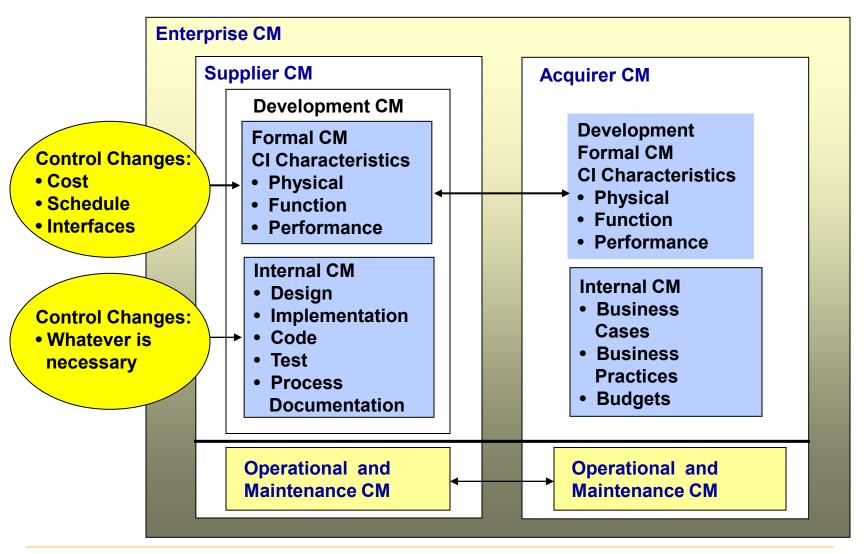
# **Application of CM**

- The CM concepts presented in this course can be applied to:
  - Hardware (H/W)
  - Software (S/W)
  - Facilities

And their appropriate documentation

During Development and Operation by the Acquirer and Supplier

#### Some Levels of CM





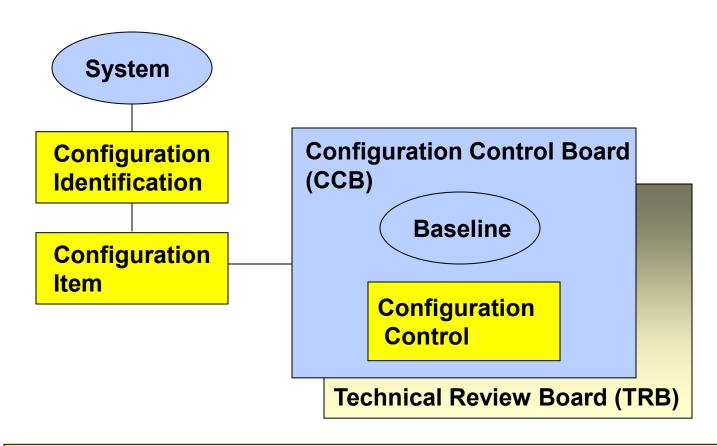
#### **Presentation Contents**

- Introduction
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- Formal CM
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  - During Operation / Maintenance
- References

# **Configuration Management Overview**



**Configuration Management Audits – Configuration Status Accounting** 

## Configuration Identification continued

- Three level of Configuration Identification are established
  - Functional Configuration Identification (FCI)

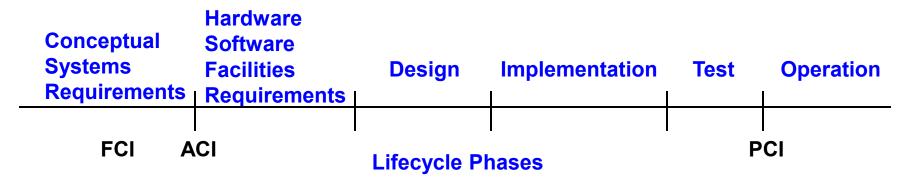


Allocated Configuration Identification (ACI)



Physical Configuration Identification (PCI)

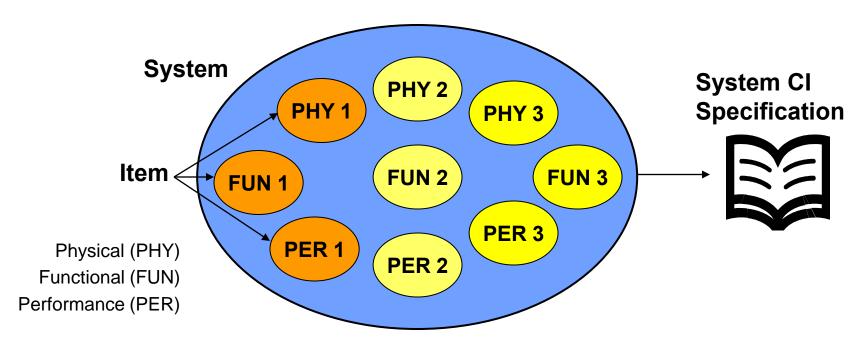




## **Functional Configuration Identification**

#### Functional Configuration Identification (FCI)

The identified system and system items and their physical, functional, and performance characteristics which are documented in a System Specification

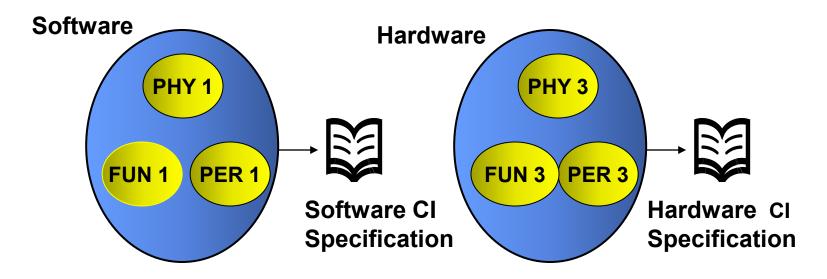




## **Allocated Configuration Identification**

#### **Allocated Configuration Identification (ACI)**

Later in development the physical, functional, and performance characteristics of the system are allocated to lower level entities: software, hardware, facilities, and are documented as Allocated Specifications for requirements

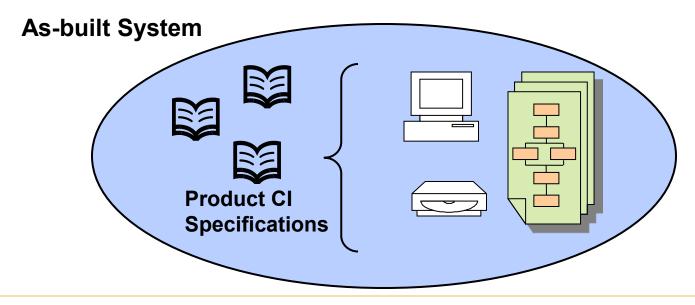




## **Physical Configuration Identification**

#### Physical Configuration Identification (PCI)

Finally, the products of the developed system: software, hardware, facilities are defined in a series of Product Specifications that describe the as-built system

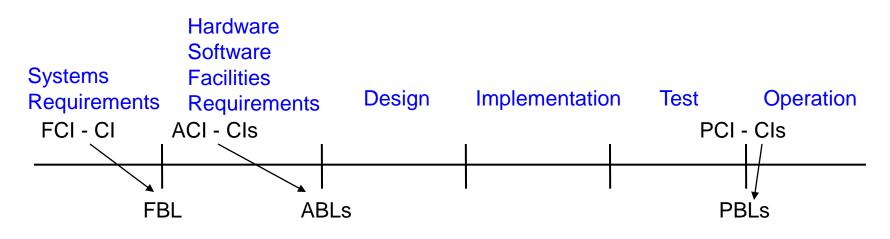




#### **Formal Baselines**

Baselines are established at strategic points in a system lifecycle. Three baselines may be defined

- Functional Baseline (FBL)
- Allocated Baseline (ABL)
- Product Baseline (PBL)

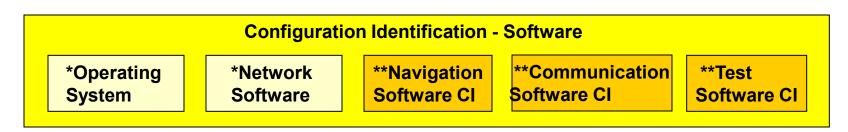


Lifecycle Phases



# Configuration Identification and Configuration Items

- Configuration Identification is an activity that identifies items and their characteristics: physical, functional, and performance
- Not all items that are identified need be controlled at the same level of rigor
- Configuration Items are selected for formal change control from items identified



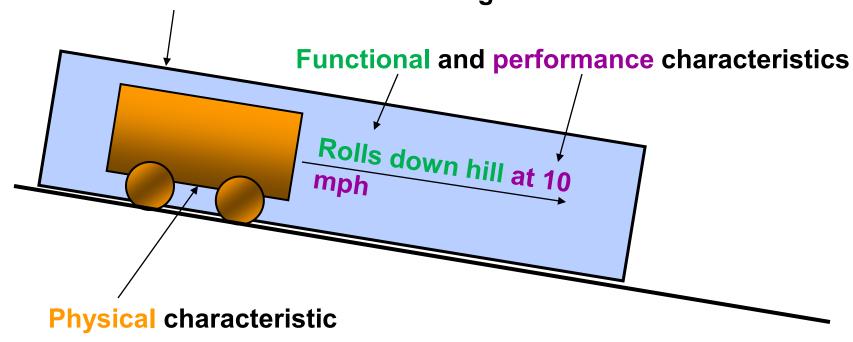
<sup>\*</sup>Commercial products MAY not be subject to change – In operation everything is under CM control

<sup>\*\*</sup>Applications software in development that is subject to change



# **Configuration Item**

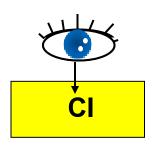
Represents the characteristics of a Configuration Item



# **Baseline vs. Configuration Items**

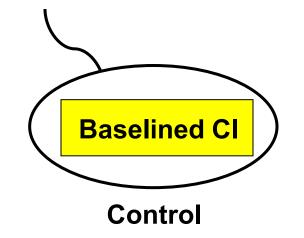
The approved and fixed (baselined) configuration of a CI at a specific time in its lifecycle that serves as a reference point for change control

Cls are used for visibility



**Visibility** 

Baselines are used for control



# **Configuration Control**

- The systematic
  - evaluation
  - coordination
  - approval or disapproval, and
  - implementation
  - of changes to the physical, functional, and performance characteristics of a baselined Cl
- Changes are requested with a Change Request (CR) form

# **Configuration Control Board (CCB)**

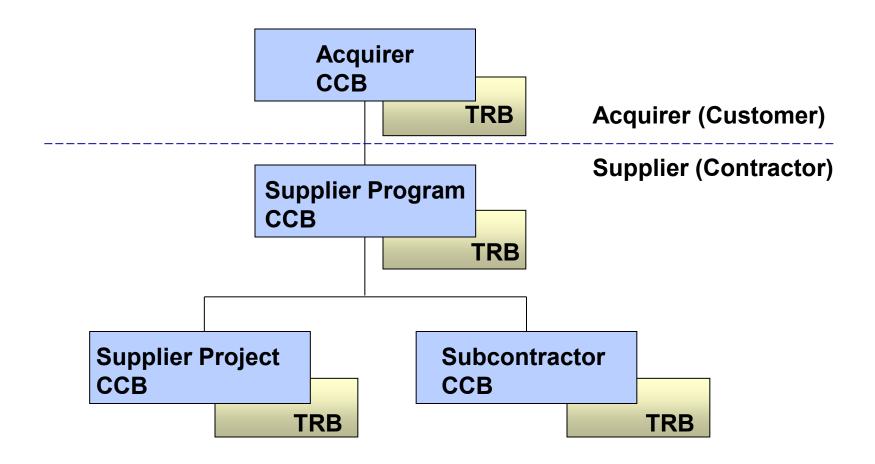
- Establishes baselines for CIs
- Reviews and approves / disapproves / defers Change Requests to Cls
- Membership comprised of management, and other stakeholders and supported by the subject matter experts
  - Project Management
  - Systems Engineering
  - Software/Hardware Engineering
  - Test Engineering
  - Quality Assurance
  - Configuration Management
- Chaired by the program / project manager or designee



# **Technical Review Board (TRB)**

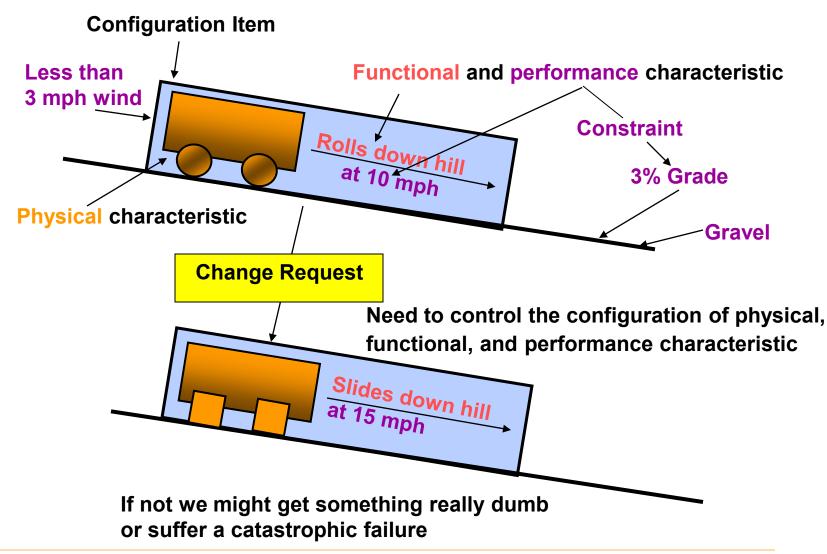
- Provides technical and programmatic support to the CCB
  - Conducts impact assessment on CRs to baselined CIs
  - Makes approval / disapproval recommendations to the CCB
- Membership comprised of program / project personnel and subject matter experts
- Chaired by a technical manager

# **CCB** and TRB Hierarchy





# **Configuration Control**





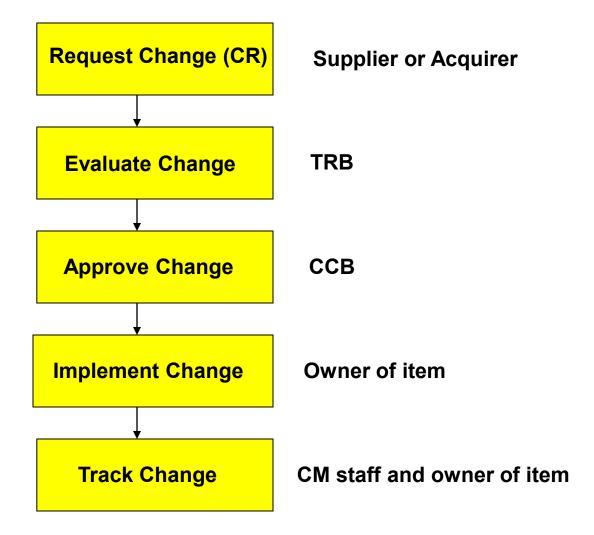
# **CR Example**

#### Change Request

| CR#  | <b>Date:</b> 12/4/2003 | Requestor: ET | Γ                | Class: |
|--|------------------------|---------------|------------------|--------|
| Problem: A requirement to deploy the probe's parachute does not exist  |                        |               |                  |        |
| Change: Add the following requirement: The probe's parachute shall be deployed .01 seconds after the heat shield has been jettisoned |                        |               |                  |        |
| Impacts: Enter figures for cost and schedule and list affected interfaces or "None" and attach impact assessments                    |                        |               |                  |        |
| Systems: Hardware: Software: Test: Configuration Management: Quality Assurance: Contracts: Other [Specify]:                          |                        |               |                  |        |
| Approve:   | TRB Date:<br>CCB Date: |               | Chair:<br>Chair: |        |
| Disapprove:  | TRB Date:<br>CCB Date: |               | Chair:<br>Chair: |        |
| Assignee:  |                        |               | Due Date:        |        |



# **Change Flow**





# **Impact Assessments**

- Impact assessments need to be conducted by all stakeholders:
  - Systems
  - Hardware
  - Software
  - Test
  - Configuration Management
  - Quality Assurance
  - Contracts
  - Others
- On CI characteristics:
  - Physical
  - Functional
  - Performance

- Against their interests:
  - Cost
  - Schedule
  - Interface

# **Classification of Changes**

At least two types of changes can be defined:

- Class I—affects the Acquirer's interest in one or more of these factors:
  - Physical characteristics
  - Functional capability
  - Performance
  - External interfaces
  - Cost
  - Schedule

Supplier must submit change to the Acquirer for approval before implementation

# Classification of Changes concluded

- Class II Does not affect any of the Class I factors, affects changes such as:
  - Spelling or typographical errors
  - Addition of clarifying comments
  - Changes that do not affect external interfaces, change functionality or degrade performance

Supplier may implement it without Acquirer's approval but must inform Acquirer of change

#### **CM** Audits

- Functional Configuration Audits (FCA) and Physical Configuration Audits (PCA) are conducted by Engineering and facilitated by CM and/or Quality Assurance (QA)
- Other audits conducted by QA and CM may include:
  - Audits of CM Repository that contains CM records, documentation, processes, procedures, artifacts, etc.
  - Audits of Program/Project organizations to ensure CM process is being followed
  - Audits of status of approved CRs
  - Audits to ensure that CIs are consistent with CM records

PCA can be prolonged until after Operational Tests

If necessary

| tation Test Operatio |
|----------------------|
| FCA/PC               |
|                      |



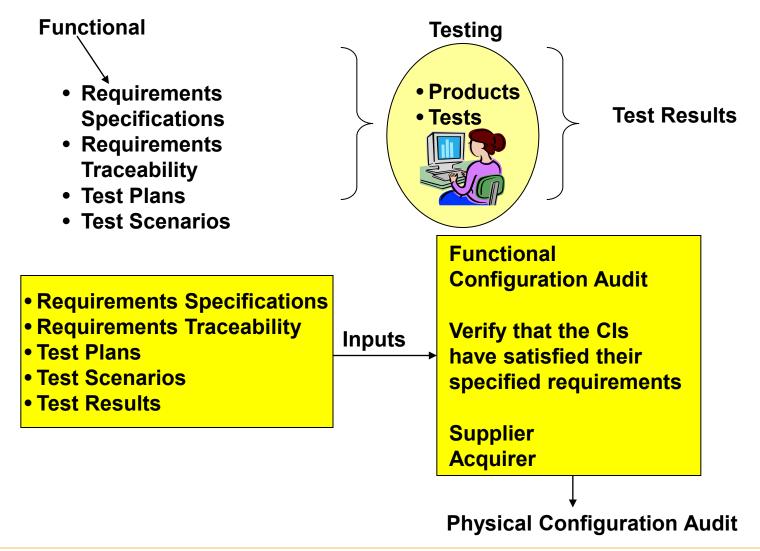
# **Functional Configuration Audit (FCA)**

- A formal examination of test results of the as-built functional configuration of CIs, prior to acceptance, to verify that the CIs have satisfied their specified requirements
- This audit is conducted by the Supplier for the Acquirer and attended by
  - Management
  - System Engineering
  - Hardware / Software Engineering
  - Test Engineering
  - QA and CM
  - Contracts

of both the Acquirer and Supplier



# Functional Configuration Audit continued



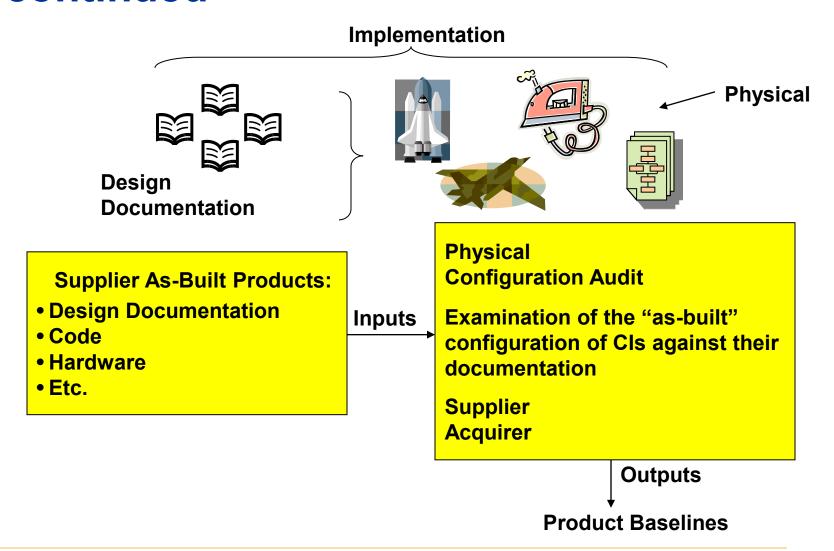
## **Physical Configuration Audit (PCA)**

- A formal examination of the as-built physical configuration of CI products against their design documentation
- This establishes the Product Baseline
- This audit is conducted by the Supplier for the Acquirer and attended by
  - Management
  - System Engineering
  - Hardware / Software Engineering
  - Test Engineering
  - QA and CM
  - Contracts

of both the Acquirer and Supplier



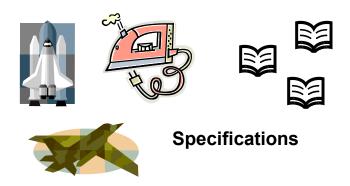
# Physical Configuration Audit continued



# Configuration Status Accounting (CSA)

 CSA is performed to gather, correlate, maintain and provide status on controlled products (CIs),

and on CM tasks



**Products (CIs)** 

Configuration Identification

Configuration Control

Configuration Audits

Configuration Audits

Configuration Status Accounting

**CM Tasks** 

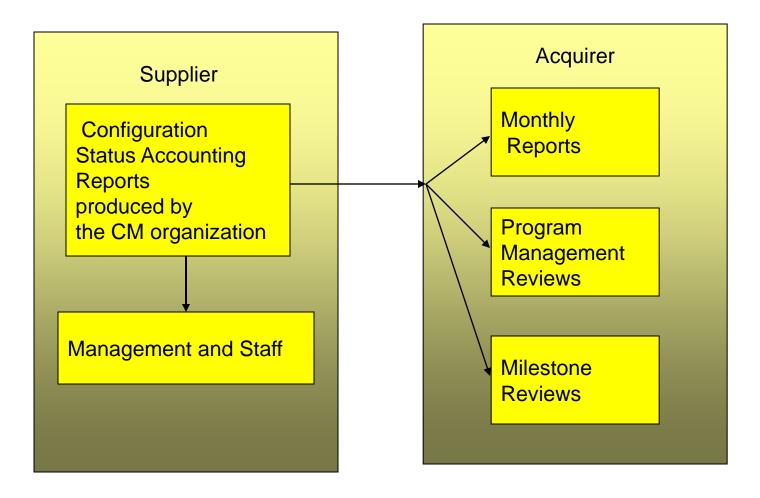
# Configuration Status Accounting continued

- The Configuration Status Accounting (CSA) task gathers, correlates, maintains, and provides status on CM controlled products and CM tasks
- Provides the means for reporting status on:
  - Configurations
    - FCI
    - ACI
    - PCI

- Baselines
  - FBL
  - ABL
  - PBL

- Other
  - CM metrics
  - CM activities
  - CM Audits

# Configuration Status Accounting concluded





### **Presentation Contents**

- Introduction
  - Reasons for Configuration Management (CM)
  - CM Concepts
- Formal CM
  - Formal Baselines and Configuration Items (CIs)
  - Configuration Control Boards (CCBs)
    - Supported with Technical Review Boards (TRBs)
  - Change Control
  - CM Audits and Status Accounting
- Internal CM
  - Internal Baselines
  - CM of Design, Code, Hardware Items, Test Articles
  - Operation CM
    - During Operation / Maintenance
  - References



## Internal CM versus Formal CM

- Formal CM is concerned with
  - High Level baselines
    - FBL
    - ABL
    - PBL
  - Master Schedules
  - Contractual Items
- Internal CM is concerned with
  - Design BL
  - Code BL
  - Hardware component BL
  - Test BL
  - COTS BL
  - Etc.



### **Internal CM Concerns**

#### Documents

- Database
- Test procedures
- Analysis that drive requirements and design
- Etc.

#### Plans

- Project plans
- CM plans
- QA plans
- Risk Management plans
- Test plans
- Etc.



# Formal CM Under Configuration Control Board (CCB)

- Configuration Control Board is Chaired by PM
- Membership composed of management
  - Systems
  - Software
  - Hardware
  - Test
  - -CM
  - -QA
  - -Etc.

# Internal CM Under Technical Review Board (TRB)

- Chaired by Deputy PM or Lead Systems Engineer
  - Systems
  - Software
  - Hardware
  - Test
  - -CM
  - -QA
  - -Etc.

MITRE

### Internal CM Concerns continued

#### Internal CM is concerned with

- Version Control
  - Documents
  - Code
  - Hardware items
  - COTS
- Data Management
  - Documents
  - Plans
  - Process Documentation
  - Procedures
  - Metrics
  - Action Items
  - Etc.



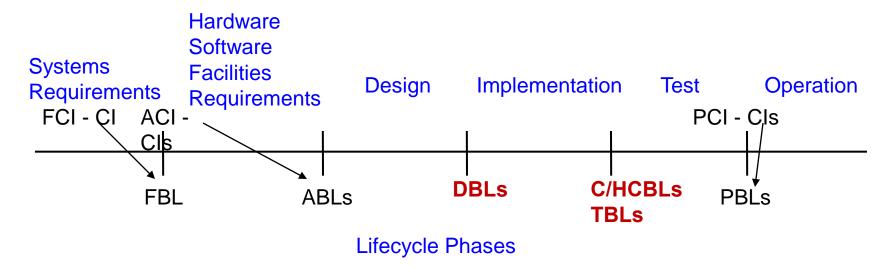
## **Internal CM & Testing**

- Internal CM during testing is concerned with
  - Code changes (TRB)
  - Design changes (TRB)
  - Test case changes (TRB)
  - Requirements changes (Require escalation to CCB)

### **Internal Baselines**

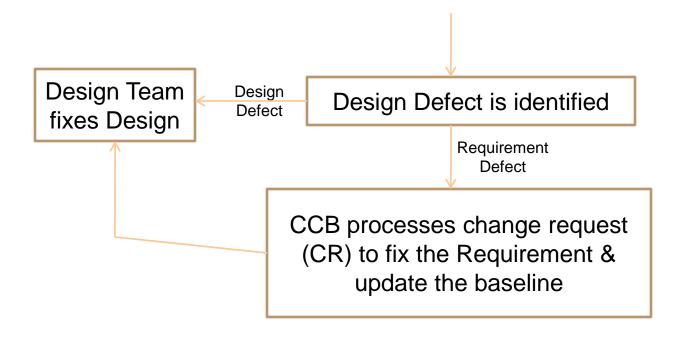
Internal baselines are established at strategic points in a system lifecycle. Three internal baselines may be defined

- Design Baseline (DBLs)
- Code/Hardware Components Baseline (C/HCBLs)
- Test Baseline (TBLs)



## **Internal CM During Design**

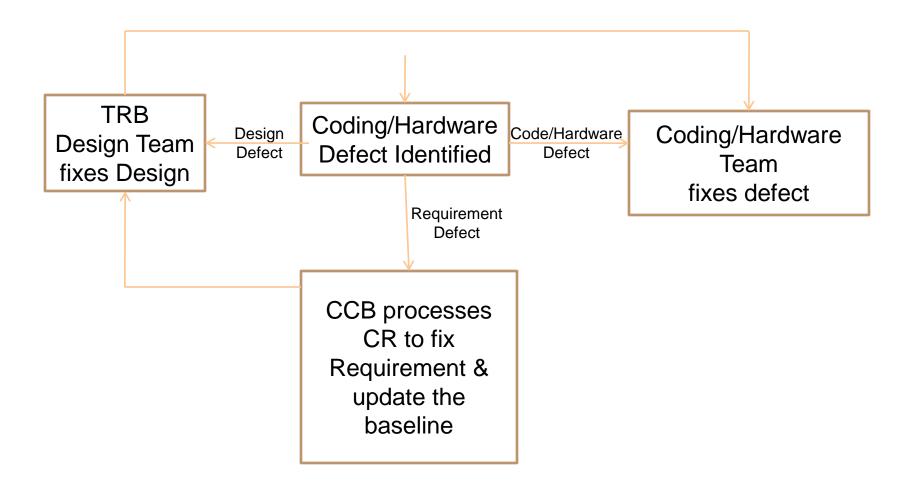
#### **Design not yet Baselined**





# **Internal CM During Coding**

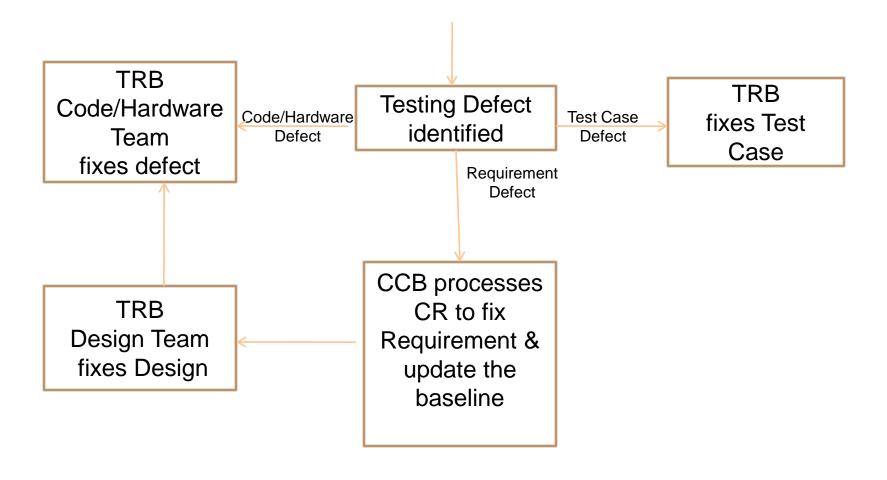
Design Baselined, Code not Baselined





# **Internal CM During Testing**

Design, Code & Test Cases Baselined





## **CM** During Operation

- Operation CM does not differ from CM conducted during development
  - Formal CM
  - Internal CM
- The players may change
  - A different Operation contractor
  - A different Operation agency
    - Acquisition Agency vs. Operation Agency
- The Operation Baseline has been established



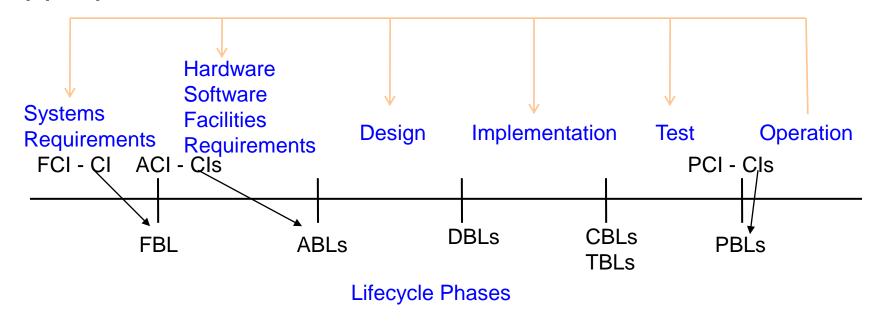
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  - Internal Baselines
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- Operation CM
  - During Operation / Maintenance
  - References



# **CM During Operation continued**

Defects and changes during Operation may require repeat of activities that were conducted during development and reestablishment of baselines as appropriate.





## References/Suggested Reading

- IEEE Std. 828-1998 IEEE Standard for Software Configuration Management Plans
- IEEE 1042, Guide to Software Configuration Management
- ANSI/EIA-649-1998 National Consensus Standard for Configuration Management
- IEEE 828-2005 Standard for Software CM plans
- MIL-STD-973 Military Standard for Configuration Management (cancelled, but still good reference)
- CM Today Yellow Pages, Your Source for Daily CM News, www.cmtoday.com/yp/configuration\_management.html
- CM BoK Configuration Management Body of Knowledge. www.cmcrossroads.com/cgi-bin/cmwiki/bin/view.cgi/CM/ CMBoK, CM Crossroads, CM Community Forums
- Capability Maturity Mode Integration (CMMI®), Version 1.3 Software Engineering Institute



### **Contact Information**

Al Florence florence@mitre.org 703 983 7476





# Using CMMI® Effectively for Small Business

#### — Panel —

(With interactive discussion from panel and audience recorded in slides)

NDIA CMMI® Working Group NDIA Systems Engineering Division 2010 CMMI Technology Conference

#### Is CMMI for Small Business?



# The NDIA CMMI Working Group was tasked to investigate common questions on the applicability of CMMI to small business

- Is CMMI appropriate for small businesses?
- Is CMMI a barrier to competition in the defense market?
- What data substantiates the adoption of CMMI by small business?
- What challenges do small businesses face for adoption?
- How can acquirers use CMMI to manage their acquisition risks with small suppliers?



Reference: 'CMMI for Small Organizations', NDIA CMMI Working Group, CMMI Conference, Nov 2010.

Panel discussions will be recorded in this slide set, as applicable.

# Panelists – Using CMMI Effectively for Small Business



Lynn Penn
Lockheed Martin

Girish Seshagiri Advanced Information Services (AIS)

Rosalind Singh
Raytheon Company

Dr. Rick Welch Northrop Grumman

# What advantages and obstacles do small businesses face relative to CMMI adoption?



| Small Business Advantages  | Small Business Obstacles  |
|--|---|
| <ul> <li>Innovation, speed, agility</li> <li>Commonality across projects, tailoring?</li> <li>Fewer communication paths</li> <li>Simpler process/tools (low tech solutions)?</li> <li>Easier institutionalization across projects?</li> </ul>  | •CMMI: too big, too complex? Sometimes more perception than reality – usually appears in plans •Fewer dedicated resources (staff, \$). Everybody is a shared resource, sharing time with competing demands. •Roles, responsibilities - multiple hats (QA, Test, Process Group, training,) •Infrastructure/overhead costs, amortization? •Cultural resistance or bias? |
| <ul> <li>Fewer people filling multiple roles allows easier to connect the dots</li> <li>Able to be more nimble, react to changes more quickly</li> <li>Fewer approvals and needed, greater coverage.</li> <li>Less documentation needed for fewer people – 1 page descriptions can suffice. Set thresholds, entry/exit criteria, etc.</li> <li>Alignment and communication of objectives is straightforward. Clear rationale for process changes.</li> </ul> | Small project, site, organization Run out of people to provide objective input. Must procure external resources to provide feedback. Can be difficult to restructure existing working relationships – doing things differently. "Culture eats process for lunch"  |

# Improving Processes in Small Settings (IPSS)



Just enough process, just in time to support the needs in small settings

Obstacles were outweighed by the advantages – similar to the prior slide

Integrating best practices, listening, facilitating

**Defining the process tolerance** 

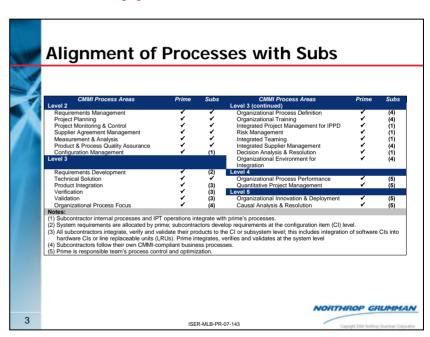
## **Supporting Small Suppliers**



# Acquirers (such as prime contractors) often use CMMI practices to select, manage, and support their small suppliers.

# Typical uses of CMMI within larger companies when working with smaller suppliers:

- CMMI maturity level requirements rarely specified to subs unless levied by external customer
- Use CMMI practices in key areas to evaluate supplier risks
- Checklists or tools used for supplier selection
- May require suppliers to follow prime contractor's processes
- Provide direct support to suppliers training, mentoring, tools, etc.
- Customize areas of interest per the situation.
- Subcontracting, partnering
- Find gaps that need to be filled (e.g., EVMS, federal contracting)
- Smaller companies may not have in-house expertise in some CMMI PAs (e.g., HiMat)



<u>Reference</u>: "High Maturity System/Software Cost Estimation", Richard L. W. Welch, PhD., Northrop Grumman Integrated Systems CMMI Technology Conference, November 2007.

http://www.dtic.mil/ndia/2007cmmi/Wednesday/4pmWelch.pdf

## Risk Based Subcontractor Assessment

**Lockheed Martin Corporation** 

# **Developed Resources**

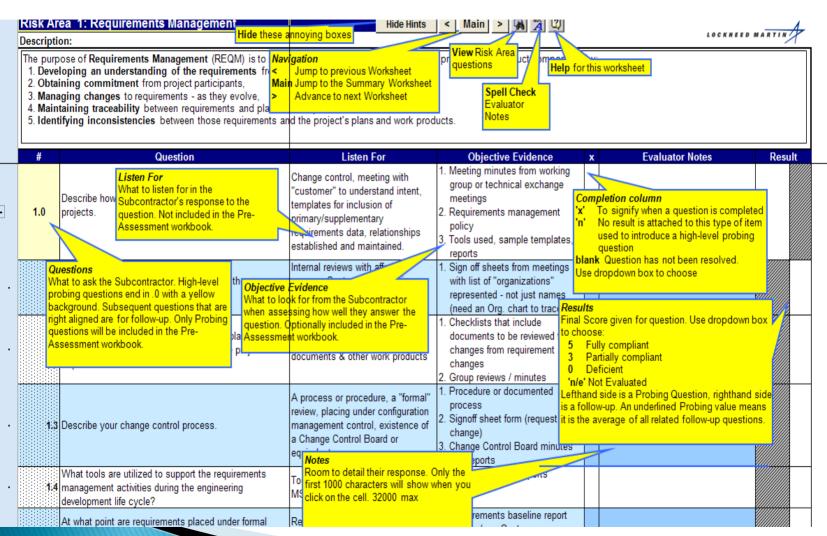
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  - Comprehensive questionnaires
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  - Tailoring (adding / deleting)
  - Summary roll-up



### Screen Shot of Summary Sheet of RBAT

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#### Screen Shot of Risk Sheet of RBAT



# What risks or issues do acquirers see from working with small suppliers?



| Risks / Issues  | Acquirer Mitigation Approach? |
|---|-------------------------------|
| <ul><li>Processes: completeness, integration?</li><li>Product reqts, interfaces, integration?</li></ul> |                               |
|   |                               |

# How do you approach integrating prime/supplier processes and products?



#### **Process/product integration techniques**

•Common processes/tools? Integrated processes/tools? Separate processes/tools?

# What recommendations do you have for small businesses interested in adopting CMMI?



#### Recommendations

- •Look at your teams PSP, TSP. Within 2 years planning processes will be in place. Do gap analyses to improve. Achieve ML3 in 36 months, Level 5 using PSP/TSP.
- •Use the company's culture and terminology to communicate in their terms not CMMI.
- •Appraisals used to be discovery oriented appraisal did the evaluation and mapping to CMMI. Now, the emphasis is on preparing artifacts and evidence, with little value to the business.
- •Top management buy-in important in companies of all sizes.
- •Language used in CMMI can be difficult to relate to more in the context of a large defense contractor. Translation to a small company can be very difficult.
- •Treat process improvement like a project project plans, etc.

#### For More Information....



#### **NDIA CMMI Working Group**

http://www.ndia.org/Divisions/Divisions/SystemsEngineering/Pages/CMMI Working Group.aspx

Jim Armstrong
Stevens Institute

**Geoff Draper**Harris Corporation

Wendell Mullison General Dynamics, Land Systems Steve Austin
Lockheed Martin

Jeffrey L. Dutton
Jacobs Technology

Rick Welch Northrop Grumman **Dan Blazer** 

SAIC

Nancy Fleischer Raytheon Company Michael Campo

Raytheon Company

Kathy Smith
Hewlett Packard EDS

#### With special appreciation to our panelists:

Lynn Penn, Lockheed Martin Rosalind Singh, Raytheon Company Rick Welch, Northrop Grumman Girish Seshagiri, AIS

## Risk Based Subcontractor Assessment

**Lockheed Martin Corporation** 

# Risk Based Subcontractor Assessment Topics

- Issues
- Identification of Risk Areas
- Developed Resources
- Initial and On-going Evaluations
- Risk Areas for Evaluation
- Risk Area Questionnaire
- Risk Report
- Summary

# Issues - Impacts to Mission Success

- Analysis has shown that engineering subcontractors may impact Lockheed Martin Company program success
  - Subcontract content and design responsibility on programs continues to grow
  - Lack of diligence in subcontract management can be a primary cause of program failure
- Issues become more obvious when the subcontractor is:
  - A major program contributor (greater than 10% of the total contract value)
  - A Sole Source supplier
  - On the program critical path
  - Considered a medium to high risk to program performance
  - New to Lockheed Martin with no performance history
  - A past supplier to Lockheed Martin with problematic performance history

# Identification of Risk Areas

- Multiple studies conducted to identify key risk areas
  - Multiple recurring problem themes
  - Results were consistent with the Software Engineering Institute's CMMI for Development model
- Adopted the framework of CMMI-DEV to focus on the likelihood of a subcontractor's success

# **Developed Resources**

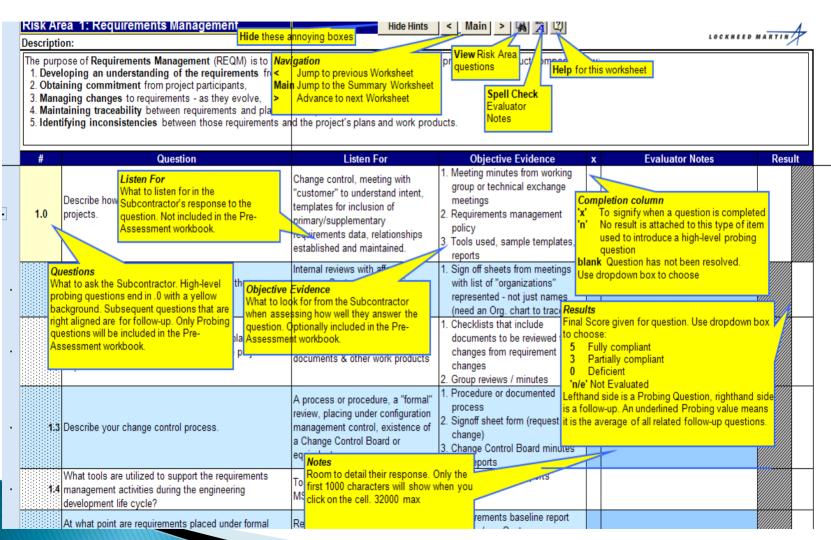
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  - Comprehensive questionnaires
  - Scoring/Weighting
  - Tailoring (adding / deleting)
  - Summary roll-up



# Screen Shot of Summary Sheet of RBAT

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#### Screen Shot of Risk Sheet of RBAT



# Initial and On-Going Evaluations

# Differences in two types of Evaluations

|                                      | Initial  | On-Going  |
|--------------------------------------|--|---|
| When                                 | Prior to Contract Award  | Anytime after Contract Award:<br>Regular intervals or on demand |
| Duration                             | 1 – 2 days   | 1 day   |
| Emphasis                             | Generalized Fact Finding   | Project implementation and risk                                 |
| Quantitative<br>Results<br>Important | Yes – for multiple<br>Subcontractor Evaluation<br>No – for sole source | No  |
| Scope of Review                      | Subcontractor  | Subcontractor, Lockheed Martin Prime, Customer                  |
| Risk Areas                           | Potentially all  | Can be more focused, depending on the lifecycle phase           |

# Risk Area - Starter Set

17 key Risk Areas, but what constitutes a good "starter set"?

- Requirements Management
- **...** Risk Management
- Verification
- **...** Validation
- Measurement and Analysis
- ...and perhaps Supplier Agreement Management, if next tier suppliers exist

Tool allows for tailoring, prioritizing, and custom probing

# Risk Area Questionnaire

#### Probing a Risk Area - Best Practices

- Keep it simple
- Limited number of good questions
- Backup questions (for added clarity)
- Review objective evidence if available
- Be mindful of expected responses
- Look for integration themes (threading)
- Tailor/add/delete/prioritize questions for effectiveness
- Note risks as they are uncovered
- Keep Subcontractor grading feedback to a minimum during evaluation
- Limit evaluation duration (within a day in most cases)
- Generate a risk report and execute to it

# Risk Reports

- No Subcontractor is a perfect match
- Using a standard evaluation strategy and querying multiple potential risk areas should
  - Provide a more accurate portrayal of Subcontractor capability earlier in the lifecycle
  - **Enable** risk management kickoff, when necessary
  - Ultimately strengthen the LMC/Subcontractor relationship



# Summary

- Guidebook and Tool provide our LM companies with information that enables:
  - More confident source selection
  - On-going review / risk management during a program's development cycle
  - More sharing of subcontractor evaluation data across the corporation
- Process and tool can be used with any size Subcontractor

Completing an assessment <u>AND</u> proactive risk management compose the solution framework

# Process Alignment From Aligned to Aligner

Ilene Pinsker Sr. Systems Engineer Rockwell Collins, Inc. Simulation and Training Solutions November, 2010





# **Agenda**

- Background Information
- Simulation and Training Systems (STS) Alignment to Rockwell Collins (RC)
- Visual Systems (VS) Alignment to STS
- Observations and Lessons Learned
- Ongoing Activities



# Rockwell Collins, Inc. (RCI)

- International provider of communication and aviation electronics solutions
- Mature processes
- CMMI Level 3
- Developing plans for CMMI future





#### **NLX**

- Small, privately owned company
- Built military and commercial full flight simulators
- Engineering facilities in Sterling VA, Binghamton NY and Huntsville AL
- Immature processes
- ISO certified
- Developing plans for CMMI Level 3
- Acquired by Rockwell Collins in December, 2003
  - NLX became Rockwell Collins Simulation and Training Solutions (STS)



## **Evans and Sutherland (E&S)**

- Small company which created visual image generators
- Provided many of the image generators used in the simulators built by STS
- Engineering facilities in Salt Lake City UT, Orlando FL and Horsham, England
- Immature processes
- ISO certified
- No plans for CMMI
- Acquired by Rockwell Collins Simulation and Training Solutions in May, 2006
  - Evans and Sutherland became STS Visual Systems (VS)

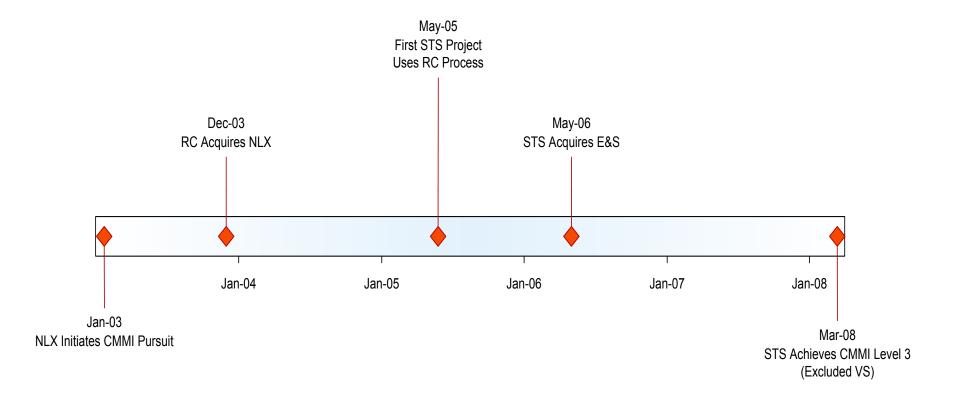


## **Alignment Objectives**

- Integrate STS into the RC Quality Management System
- Transition to RC Enterprise Tools
- Retain STS Best Practices
- Maintain ISO 9001:2000 Certification during transition and after alignment
- Achieve CMMI Level 3



## **Timeline**





#### **RC Contrast To STS**

- Rockwell Collins product
  - Transitions to factory production
  - Requires FAA or equivalent certifications, such as DO178B
- STS product
  - Each simulator contract is for a custom-built device which doesn't require large scale production
  - Simulators are not flight worthy systems, so they don't require FAA certifications



#### STS and CMMI

- Although ISO certified, the CMMI requirements brought many new challenges for STS
  - No one at STS knew the CMMI
    - 2 people were sent to the SEI for the Introduction to the CMMI training
  - STS processes merely provided a starting point for CMMI
    - Too high level
    - Some process areas not included
  - Where do we begin?





# **Process Alignment**

- Rockwell Collins processes were CMMI compliant!
- Can the same organizational standard process be used for simulators?
- What about the legacy STS processes?
- The vetting process began with much push-back from the practitioners that did not welcome change
  - "The process is oriented to a production environment"
  - "We don't build flight worthy systems and don't have the same safety requirements"
  - "The people in Cedar Rapids don't understand our unique product needs"
  - "Our process is working, why do we need to change it?"
  - "Our customers are happy, why change?"



## **Process Alignment**

- Representatives from Rockwell Collins provided mentoring on the RC Design and Development processes
- STS representative added to the RC Government Systems Organizational Process Group (OPG)
- STS Team
  - Lead by Engineering Processes and Tools and Software Quality
  - Functional area representatives
    - Quality Engineering
    - Engineering Systems, Hardware and Software
    - Operations
    - Manufacturing
    - Project Management
- Each STS process was compared to the RC processes
  - Is there an existing RC process?
    - Can RC/STS use it as is?
    - If not, can it be modified to include unique product requirements?
    - If not, convert the legacy STS process to RC format
      - Due to tailorability of RC process, few processes were converted
    - New programs were required to follow the resulting process
  - RC provided training as well as mentoring
  - Institutionalization was gradually achieved



# **Initial Findings**

|             | RC Process  | STS Legacy<br>Process  | Result   |
|-------------|---|--|--|
| Management  | Entire life cycle (Business opportunity identification through program completion)  | Starts at contract award   | Replace legacy process with RC process   |
| Engineering | <ul> <li>RC technical process includes<br/>areas that are not applicable to<br/>STS (i.e. ASIC, manufacturing<br/>transition)</li> <li>Well defined tailoring tool</li> </ul> | Hardware and software process can be directly mapped to RC process | New programs to use<br>RC process and tailor<br>out areas that are not<br>applicable |
| Quality     | <ul><li>Software Quality Engineering<br/>(SQE)</li><li>Design Quality Engineering<br/>(DQE)</li></ul>   | •Quality Inspectors •Newly Software Quality position               | RC to mentor<br>development of SQE<br>and DQE positions at<br>STS                    |
| СМ          | Process includes configuration management and control   | •CM process can be mapped to RC •Toolset is different              | New programs to use<br>RC CM process and<br>tools                                    |



## **Tool Alignment**

- Engineering Tools
  - Process does not require use of specific tools, but many are highly recommended
  - Each RC standard tool was evaluated individually, this often included pilots
  - STS representative on the RC Tool Disposition Board

|                                      | RC Standard   | STS   | Result  |
|--------------------------------------|---|---|---|
| Design and<br>Development<br>Process | RC developed tailoring tool   | No formal tool  | Use RC tool   |
| Requirements<br>Management           | DOORS   | Excel Spreadsheet                                     | DOORS is recommended, but decision is program dependent                       |
| Configuration<br>Management          | Subversion  | Razor   | New programs use Subversion<br>Legacy programs continue with<br>existing tool |
| Data Repository                      | TeamSpace – RC<br>application of Microsoft<br>Windows SharePoint<br>Services<br>Shared Drives | Electronic<br>Database<br>Management<br>System (EDMS) | STS programs continue to use EDMS   |
| Peer Reviews                         | RC developed tool   | EDMS  | Continue to use EDMS  |



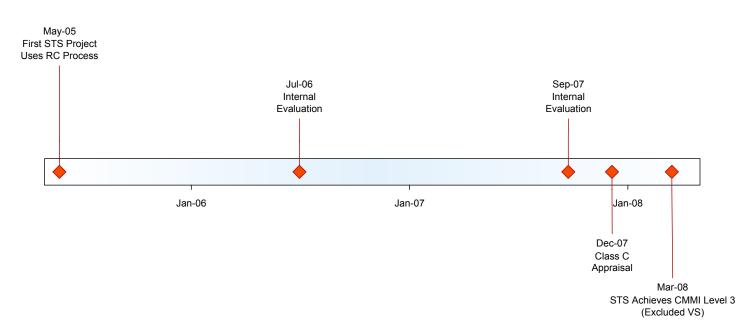
#### **Roll Out**

- Communication
  - Briefings to senior management and program management
  - Quality oversight during program planning
  - Informative e-mails
- Training
- Pilot project
  - New full flight simulator
  - Required to achieve CMMI Level 3 within 36 months of contract
    - Highly motivated to use the RC CMMI compliant processes
  - Transition team mentoring
    - Trained project team on new process and tools
    - Guided project leaders through the tailoring process
    - Worked with team to assure all process required artifacts were developed
- Quality audit checklists developed to assure compliance to the project's tailored process



#### **CMMI Level 3 Achievement**

- Shortly after roll out, CMMI activities began
- The need for CMMI provided impetus for institutionalization
- Cedar Rapids team performed CMMI Internal Evaluations
  - July, 2006 and October, 2007
- Class C Appraisal December, 2007
- CMMI Level 3 achieved March, 2008





# Visual Systems

- The transition from STS to RC processes was well underway when STS Visual Systems (VS) entered the picture
- They needed to align with the RC Design and Development processes to eventually achieve CMMI Level 3
- The VS product transitions to the factory
- VS programs customize the basic product for specific purposes with no factory production
- The role of the transition team was now reversed
- Where do we begin?





#### Been There, Done That

- Recent alignment activities gave transition team good perspective
  - Desire to retain existing process
  - Need for buy-in from practitioners
    - "The STS process is not oriented to a production environment"
    - "You don't understand our unique product needs"
    - "Our process is working, why do we need to change it?"
    - "Our customers are happy, why change?"
    - "We have many very short duration programs"
  - Analyze current processes and tools
    - Identify process gaps
    - Identify and retain best practices



## **Process Alignment**

- Quality audits to identify process gaps
  - Used the checklists which were developed to audit STS projects
  - Assigned actions to close gaps
    - Start following process
    - Tailor process for unique VS needs
- Representatives from STS provided mentoring on the RC Design and Development processes with support from RC
- RC processes were evaluated for applicability to VS
  - Can the process be used as is?
  - If not, can it be modified to include unique VS requirements?
  - If not, create a new process
- VS Team
  - Lead by VS Quality and STS Engineering Process and Tools
  - Functional area representatives
    - Quality Engineering
    - Engineering Systems, Hardware and Software
    - Project Management
    - Product Management
  - New programs were required to follow the resulting process
  - STS and RC provided training as well as mentoring
  - Institutionalization is progressing



# **Initial Findings**

|             | RC/STS Process  | VS Legacy<br>Process   | Result  |
|-------------|---|--|---|
| Management  | Entire life cycle (Business opportunity identification through program completion)                    | Starts at contract award   | VS needs to replace<br>legacy process with RC<br>process                              |
| Engineering | •RC technical process •Well defined tailoring tool  | Hardware, software and database processes can be directly mapped to RC process | New programs can use<br>RC process and tailor<br>out areas that are not<br>applicable |
| Quality     | <ul><li>Software Quality Engineering<br/>(SQE)</li><li>Design Quality Engineering<br/>(DQE)</li></ul> | Quality Inspectors and<br>Engineers – not same<br>as the SQE and DQE<br>role   | STS to mentor<br>development of SQE<br>and DQE positions at<br>VS                     |
| СМ          | Process includes configuration management and control   | •CM process can be mapped to RC •Toolset is different                          | New programs will use<br>RC CM tools  |



# **Tool Alignment**

- Engineering Tools
  - Each RC and STS standard tool was evaluated individually, this often included pilots

|                                      | STS  | VS  | Result  |
|--------------------------------------|--|---|---|
| Design and<br>Development<br>Process | RC developed tailoring tool                        | No formal tool  | Use RC tool   |
| Requirements<br>Management           | DOORS or Excel<br>Spreadsheet                      | No formal tool  | Transition to DOORS   |
| Configuration<br>Management          | Subversion   | ClearCase   | <ul><li>New programs use<br/>Subversion</li><li>Legacy programs continue<br/>with existing tool</li></ul> |
| Data Repository                      | Electronic Database<br>Management System<br>(EDMS) | •TeamSpace – RC<br>application of<br>Microsoft Windows<br>SharePoint Services<br>•Shared Drives | New programs use EDMS   |
| Peer Reviews                         | EDMS   | No formal tool  | EDMS  |



#### **Roll Out**

- Communication
  - Briefings to senior management and program management
  - Quality oversight during program planning
  - Informative e-mails
- Training
- Programs that supplied the image generator for STS programs
  - Already following parts of the process as part of the STS team
- New product development
- Include in next CMMI appraisal
- Transition team mentoring
  - Process and tool training
  - Guide project leaders through the tailoring process
  - Work with team to assure all process required artifacts were developed
- Quality audits to project's tailored process



# **Observations After Being On Both Sides**

- Practitioner buy-in is critical to success
  - Listen to them
  - Acknowledge their concerns
  - Include them in the process
  - Assure they understand the reason for change
- Leverage prior integration experience
- Audit to the acquirer's process to identify gaps
  - Alignment may be closer than you think
- Don't mandate process change
  - Communicate the business case for the change
  - "Because I said so" will lead to a process that no one follows
- The basic design and development process is the same in spite of varied end products



#### **Lessons Learned**

- Learn and incorporate the best practices of the legacy process
  - Don't assume the "acquirer" does it better. The basic Design and Development process is the same for all products
- Tailoring allows for unique business needs
- Mentoring is critical to achieve understanding
  - Include a process advocate at each facility
- Distance is a challenge
  - Involve all business locations to assure buy-in
  - Acquirer alignment team members should be at acquirer facility during the transition
- Assign specific actions, set deadlines and cadence
  - Run the transition as a program
- Transition as soon after acquisition as possible
- Select a pilot program
- Audit to the new process early in the project
- The practitioners will resist change
- Communication is critical to avoid duplication of efforts



# **Ongoing Activities to Maintain Alignment**

- Mentoring
  - Enterprise level project start-up teams
    - Process tailoring
    - Project planning
- Design and Development Governance Council
  - Approves new and updated processes
  - Representation from multiple RC Business Units and locations
    - Assures unique product needs are considered
- Internal Audits
  - Quality audits use the same checklists and criteria to assure all locations are adhering to the process











#### **Backup**

- NLX QMS
  - 125 Documents
    - 108 Procedures
    - 17 Work Instructions
  - 83 Obsolete
  - 24 RC
- E&S QMS
  - Approximately 125 Documents
  - 3 converted to RC



### **VS Quality Audit Result**

| Process                                 | Score |
|---|-------|
| Set Direction                           | 0.75  |
| Risks and Opportunities                 | 0.65  |
| Plan Project                            | 0.28  |
| Execute Project                         | 0.73  |
| Evaluate Project                        | 0.55  |
| Complete Project                        | 0.75  |
| Capture Originating Requirements        | 0.83  |
| Define Operational Concepts             | 0.25  |
| Define Requirements                     | 0.85  |
| Design Solution                         | 0.90  |
| Implement Solution                      | 0.94  |
| Integrate Solution                      | 0.83  |
| Develop Acceptance Procedures           | 1.00  |
| Develop Validation Cases and Procedures | 1.00  |
| Verify Solution                         | 0.75  |
| Support Solution                        | 0.94  |

| Legend | 0.9 - 1.00 | 0.5 - 0.89 | 0.0 - 0.49 |
|--------|------------|------------|------------|
|        |            |            |            |





### **Agenda**



- Raytheon Network Centric Systems Composition
- The Challenge
- The Solution
- Corrective Action Aging
- Overdue Corrective Action
- External CARs
- External Audits
- Internal Audits
- Supplier Assessments

### **Raytheon Company**



#### **Raytheon Company**

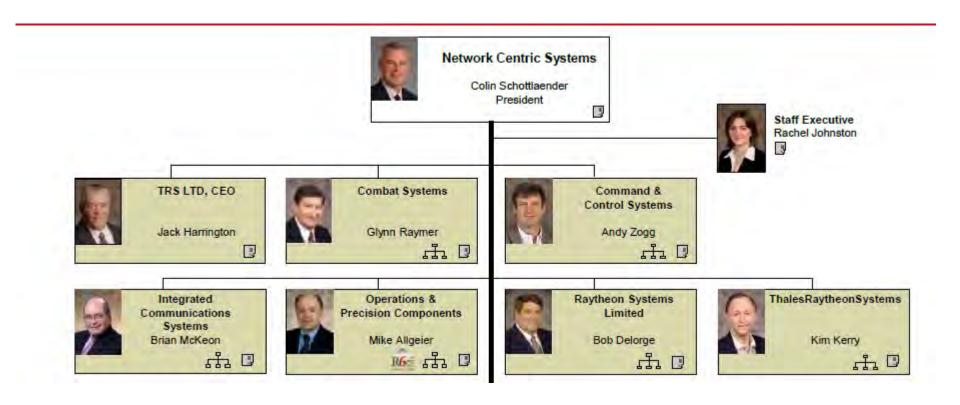
**Bill Swanson**Chairman, CEO and President



Chairman and CEO Bill Swanson \$23.2B



# Raytheon Network Centric Systems Composition



### The Challenge



- Process Evaluations conducted at the project level
  - No organizational picture of process performance
- Process Performance tracked at the regional level
  - Multiple tools used
    - Excel
    - Oracle
    - CAWeb
    - SQIDS
    - Filemaker Pro
    - ClearQuest
    - iTracker
- No organizational visibility into issues identified or processes evaluated
- Process Evaluations were engineering centric
  - Separate from ISO audit function
- Issue identification variability
- Increase in DCMA audit and escalation activity

#### The Solution

- Adopted the Raytheon Corrective Action System (RCAS)
  - Corrective Action, Audits, and Supplier Modules
- Nationalized the Process Evaluation Process
- Extended the Process to all functions
- Set goals for
  - On time process evaluation conduct vs plan
  - On time corrective action response, implementation and closure
  - On time customer corrective action closure
  - Reduction in overdue corrective actions
- Developed and delivered training to all regions regarding management expectations regarding corrective action

## Raytheon Network Centric Systems

#### What we did

- Established Regional Audit Program
- Expanded audits to functions outside of engineering
- Expanded to include ISO, CMMI, Corporate and NCS P&Ps
- Audits are now risk based to determine frequency
- Review with Program Leadership and Engineering
- Developed a series of measures and performance baselines
  - Reported monthly to leadership
  - Baseline reduction activities are continuously brainstormed
  - Embarrass the local leaders
  - Regional competition

# **Establish Process Performance Measures**

- Regional Process Evaluations
  - -Scheduled vs. completed
  - Issues per Evaluation
- CAR Cycle time
- Customer CAR Volume (level 2 and above)
- Supplier Process and Product Evaluations
- Supplier Corrective Action Cycle time

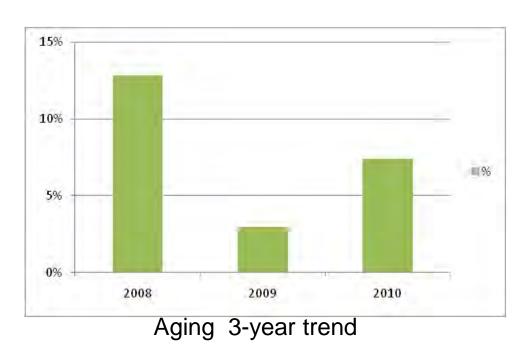
### **Establish Quality Objectives**

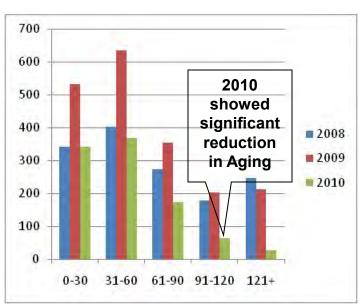
- On time process evaluations
- Timely Corrective Action closure
- Reduction in cycle time
- Timely Supplier CA closure
- Measurements are taken at the regional and organizational level

# Establish Process Performance Baselines

- Process performance baselines are defined as each measures distribution and range of results
- The goal is to understand the variation and improve the process
  - Process evaluations on schedule
  - Reduction in CAR cycle time

### **Corrective Action Aging**





Breakdown of CA Aging

Baseline is less than 25% of open corrective actions are over 60 days



Aging

# Corrective Action Aging NCS August Fiscal Month End 2010



| 4                               |                         |                     |                     |                  |             |
|---------------------------------|-------------------------|---------------------|---------------------|------------------|-------------|
|                                 |                         | +                   |                     | $\wedge$         |             |
|                                 |                         |                     |                     |                  |             |
|                                 |                         | *                   |                     |                  | Aug<br>25%  |
|                                 |                         |                     |                     |                  |             |
| MMENT: 61 of 240<br>ed actions. | O corrective actions ar | re aged >60 days. A | t the goal and will | continue to work | closures of |

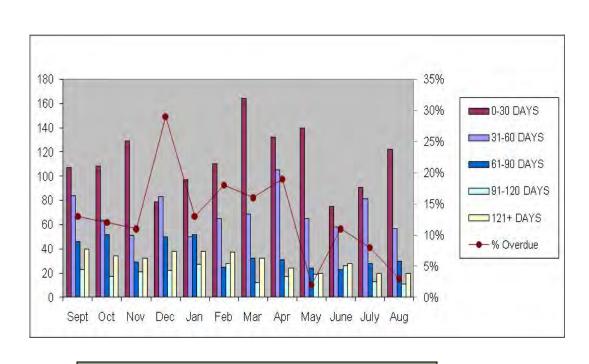
|                 | Open>60 | % Open   |          |
|-----------------|---------|----------|----------|
|                 | Days    | >60 Days |          |
| Dallas-Lemmon   | 8       | 73%      | <b>1</b> |
| Falls Church    | 0       | 0%       |          |
| Ft. Wayne       | 3       | 13%      |          |
| Fullerton (RFO) | 0       | 0%       |          |
| Fullerton (TRS) | 0       | 0%       |          |
| Goleta          | 5       | 20%      | 1        |
| Largo           | 7       | 10%      | _        |
| Marlborough     | 4       | 22%      |          |
| St. Pete        | 7       | 28%      |          |
| Texas           | 16      | 46%      |          |
| Towson          | 3       | 100%     |          |
| Waterloo        | 8       | 62%      |          |
| RSL             |         |          |          |
| Totals          | 61      | 25%      |          |

**Breakdown by Site** 

Meeting goal – continuous improvement in reducing cycle time

# Over Due Corrective Actions August 2010





| Business  | Loval | Trand |
|-----------|-------|-------|
| Dusilless | Level | Hena  |

| Site         | Overdue | %       | Total CAs |
|--------------|---------|---------|-----------|
| Site         | CAs     | Overdue | TOTALCAS  |
| Dallas-      |         |         |           |
| Lemmon       | 0       | 0%      | 11        |
| Falls Church | 0       | 0%      | 4         |
| Ft. Wayne    | 1       | 4%      | 23        |
| Fullerton    |         |         |           |
| (RFO)        | 0       | 0%      | 10        |
| Fullerton    |         |         |           |
| (TRS)        | 0       | 0%      | 5         |
| Goleta       | 0       | 0%      | 25        |
| Largo        | 0       | 0%      | 68        |
| Marlborough  | 2       | 11%     | 18        |
| Orlando      |         | 0%      | 0         |
| Bardmoor     | 0       | 0%      | 25        |
| Texas        | 3       | 9%      | 35        |
| Towson       | 0       | 0%      | 3         |
| Waterloo     | 0       | 0%      | 13        |
| RSL          |         |         |           |
| Totals       | 6       | 3%      | 240       |

**Breakdown by Site** 

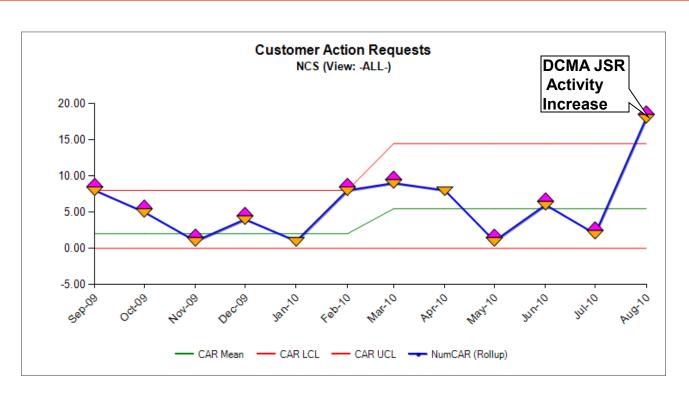
Exceeding the goal (2<sup>nd</sup> month)

Oversight continues to improve delinquent CAs

### CUSTOMER CARs August 2010



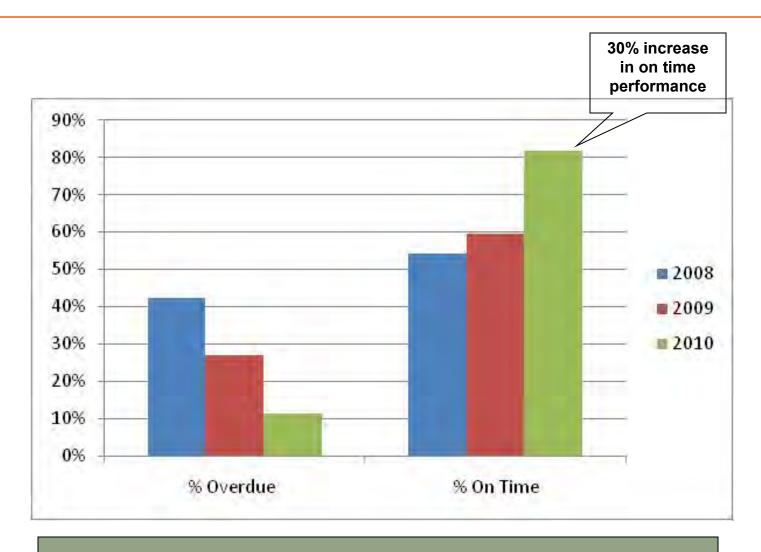




All CARs are in work and being reviewed weekly with Mission Assurance Leadership

# Process Evaluation Performance Baseline

#### **Raytheon** Network Centric Systems



### **Audit Results - Stoplight Chart**

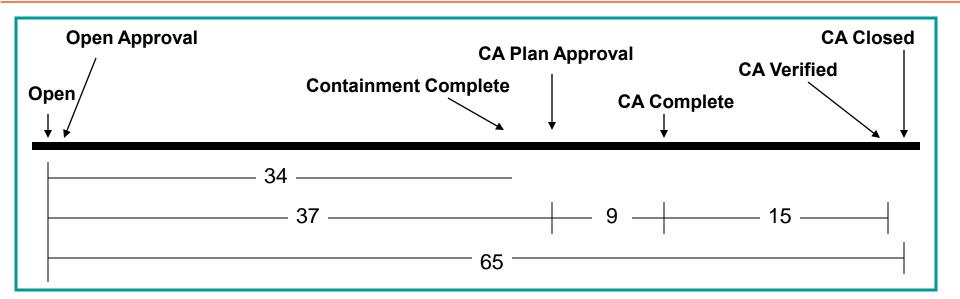


High Risk Medium Risk Low Risk N/A

|  |     |         |        |         |       | a)        |           |        |          |
|--|-----|---------|--------|---------|-------|-----------|-----------|--------|----------|
|  | NCS | Marboro | Towson | Florida | Texas | Ft. Wayne | Fullerton | Goleta |          |
| Hardware Detailed Design                 | 1   |         |        | 1       |       |           |           |        | Jan-2010 |
| Integration, Verification and Validation | 1   |         |        |         | 1     |           |           |        | Jan-2010 |
| Supplier Selection (General)             | 17  | 7       |        | 6       | 1     | 1         | 2         |        | Jan-2010 |
| Measurement, Analysis, Improvement       | 9   | 5       |        |         |       |           | 4         |        | Feb-2010 |
| Hardware Implementation                  | 4   |         |        | 2       |       |           | 1         | 1      | Feb-2010 |
| Software Implementation                  | 4   | 1       |        |         |       |           | 2         | 1      | Feb-2010 |
| Control of Design and Dev Changes        | 16  |         |        | 8       |       |           | 8         |        | Mar-2010 |
| Design and Development Review            | 14  | 2       | 2      | 1       |       | 1         | 8         |        | Mar-2010 |
| Engineering Labs                         | 45  | 4       |        | 21      | 4     | 5         | 5         | 6      | Mar-2010 |
| Program Planning Engineering             | 14  | 1       |        | 7       |       |           | 6         |        | Apr-2010 |
| Micro Program Review                     | 0   |         |        |         |       |           |           |        | Apr-2010 |
| Management Review                        | 6   | 2       |        | 2       |       |           | 1         | 1      | Apr-2010 |
| Program Planning General                 | 7   | 0       | 3      |         | 0     |           | 3         | 1      | May-2010 |
| Resource Management                      | 3   | 0       | 0      | 2       | 0     |           | 1         | 0      | May-2010 |
| Product and Process Assessment           | 14  | 2       | 3      | 3       | 0     | 2         | 2         | 2      | May-2010 |
| Production Planning                      | 4   | 2       |        | 2       | 0     |           |           | 0      | Jun-2010 |
| Software Preliminary Design              | 0   | 0       | 0      | 0       |       |           |           |        | Jun-2010 |
| Engineering Labs                         | 25  | 4       | 1      | 4       | 0     |           | 8         | 8      | Jun-2010 |
| Production Integration and Test          | 10  | 0       |        | 2       | 0     | 8         | 0         |        | Jul-2010 |
| IPDS                                     | 7   | 4       |        |         | 0     | 1         | 2         |        | Jul-2010 |
| Supplier Selection Program               | 2   | 0       | 0      | 1       | 0     |           | 1         |        | Jul-2010 |
| Supplier Selection General               | 1   | 1       | 0      | 0       | 0     |           | 0         |        | Aug-10   |
| Human Resources                          | 3   | 0       | 0      | 2       | 0     |           | 1         |        | Aug-10   |

# Anatomy of the Corrective Action Timeline Model





There are four distinct stages of CA Aging:

| Stage   | Description                 |
|---------|-----------------------------|
| Stage1A |                             |
| Stage1B | open to CA approval         |
| Stage2  | CA approval to CA completed |
| Stage3  | CA completed to CA verified |

• The correlation of each stage to the overall aging of the record:

| Open to Corrective     | Correlations | Relationship |
|------------------------|--------------|--------------|
| Action Approval        | 0.0730       | A - S1A      |
| explains 36% of th     | 0.6193       | A - S1B      |
| variation in cycle tir | 0.1318       | A - S2       |
| 1                      | 0.3054       | A - S3       |

### Next Steps

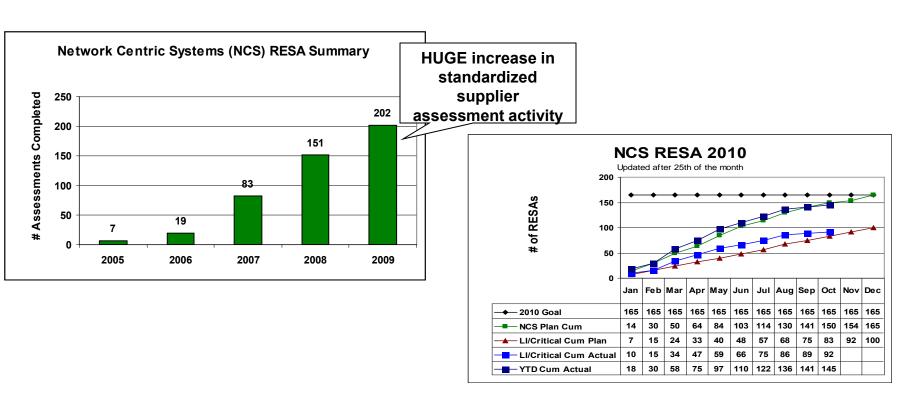


- Develop a process performance model that explains variation in:
  - Response time
  - Closure time
  - Containment
  - Rejection
- Integrate the Supplier Quality and Mission Assurance organizations

# **NEW Challenge – Integration of Supplier Quality into Mission Assurance**



Raytheon Enterprise Supplier Assessment (RESA) Activity

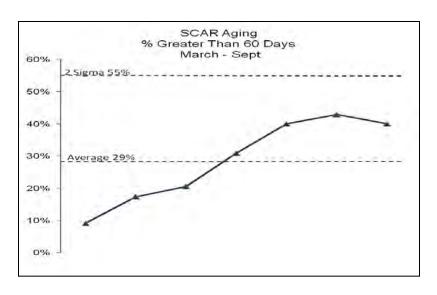


RESAs are tracked monthly with an annual goal for suppliers with emphasis on critical supplier and leading indicator programs

### NEW Challenge – Integration of Supplier Quality into Mission Assurance



#### SUPPLIER CORRECTIVE ACTION REQUEST (SCAR) ACTIVITY



|                    |         |         |         |          | Avg     |
|--------------------|---------|---------|---------|----------|---------|
|                    |         |         |         |          | Cycle   |
|                    |         |         |         |          | Time to |
|                    |         | SCARS   |         | Previous | Close   |
|                    | SCARS   | Open >  |         | Month to | For     |
|                    | Open    | 60 Days | Aug %   | Current  | SCARS   |
|                    | On Sept | On Sept | Open >  | Month    | Closed  |
| Site               | 17      | 17      | 60 Days | Trend    | In Sept |
| Dallas Lemmon      | 2       | 0       | 0%      |          | 27      |
| Ft. Wayne          | 9       | 0       | 0%      |          | 46      |
| Fullerton (RFO)    | 2       | 0       | 0%      | G        | 66      |
| Fullerton (TRS)    | 1       | 0       | 0%      |          |         |
| Goleta             | 9       | 3       |         | G        | 135     |
| Largo/StPete       | 18      | 14      | 78%     | R        | 93      |
| Marlborough        | 1       | 0       | 0%      |          | 37      |
| Mckinney           | 19      | 7       | 37%     | ()       | 70      |
| Richardson (ELCAN) | 7       | 0       | 0%      | 4        |         |
| Expressway         | 1       | 1       | 100% -  | R        | 91      |
| RSL                | 4       | 4       | 100% -  | R        |         |
| Spring Creek       | 0       | 0       | 0%      |          |         |
| Waterloo           | 0       | 0       | 0%      |          | 20      |
| Total              | 73      | 29      | 40%     | g        | 65      |

- •Challenge: Standardize and Increase the supplier surveillance presence and reduce the supplier corrective action response/closure cycle
- •Approach:
  - 2010 Started data collection with a goal to reduce cycle time with our suppliers
  - Moving to RCAS as a common tool across NCS and the Enterprise

### Lessons Learned/Results



- Dramatic increase in on-time process evaluations
- Dramatic reduction in CAR closure cycle time
- The Hawthorne effect really works!

 Next Step: Develop a predictive model to allow us to calibrate variables that cause variation in cycle time process noncompliance

### Presenter Biography-Jeff Ricketts

Dr. Ricketts has over 25 years of experience in software intensive system development in the areas of communications, air defense and air traffic control. He has been involved in the CMM/CMMI since it's inception and has participated in 12 formal appraisals (SCE/SPA/SCAMPI). He recently was part of the Raytheon NCS hardware, software and systems engineering SCAMPI effort that resulted in a repeat level 5 rating for Raytheon's Network Centric Systems five major design centers. He holds a Doctorate degree in social statistics from Washington State University. He currently Serves as the engineering liaison for the NCS Program Leadership and Mission Assurance Organization.

22



## Presenter Biography-Pam Griffin

Pam has over 25+ years experience in the industry in software and quality, working on air defense training systems, systems of systems integration and communications systems. She has been involved in CMM/CMMI for the last 10 years and currently serves on the NCS Measurement Council and the Corporate Measurement Community of Practice.





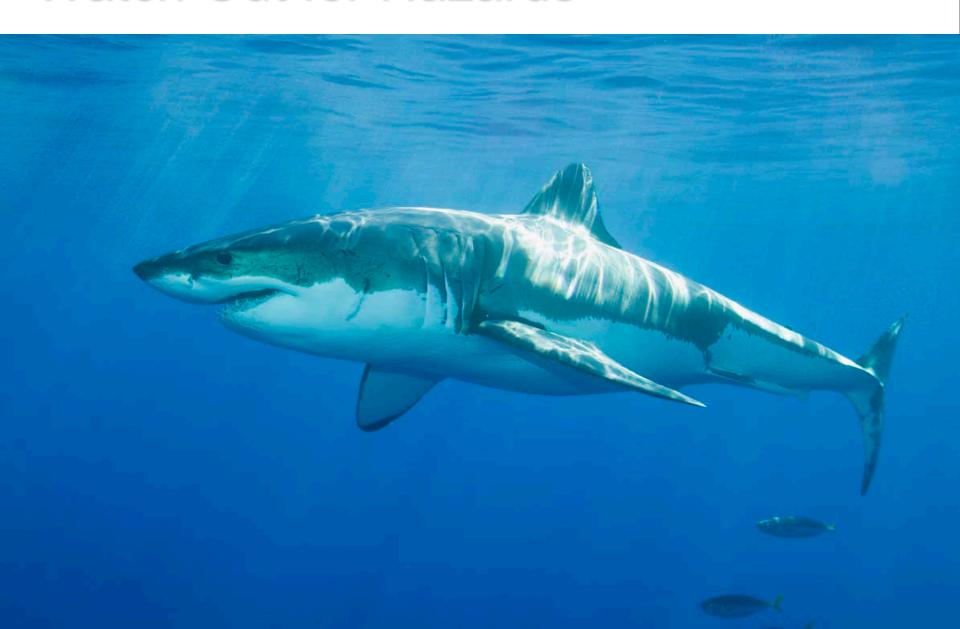
## Our Objective: Reappraisal Island



## Plan Ahead



## Watch Out for Hazards



## Hey, You've Done it Before, Right?



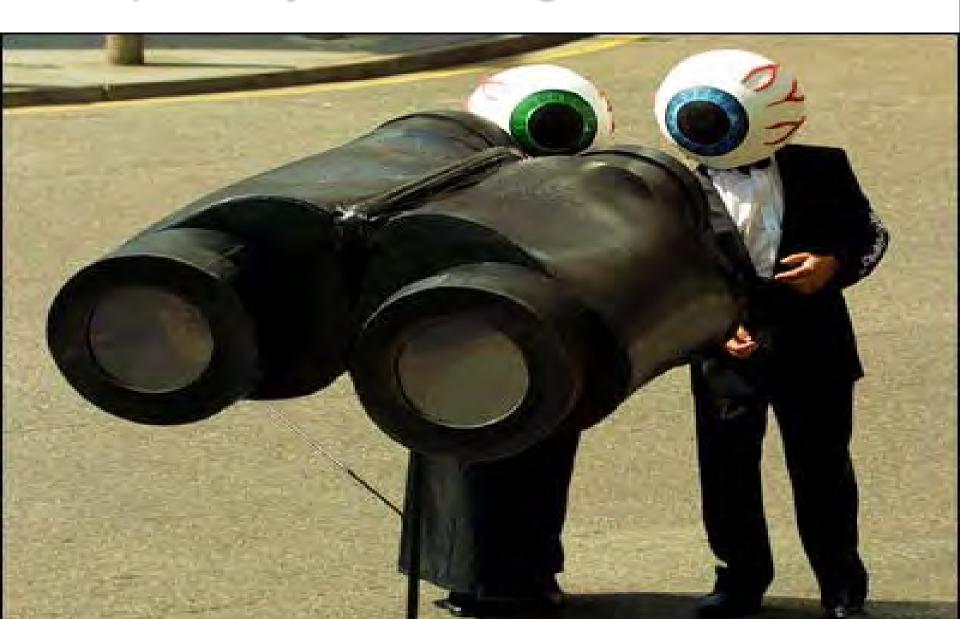
# Consistency=Stability=Success



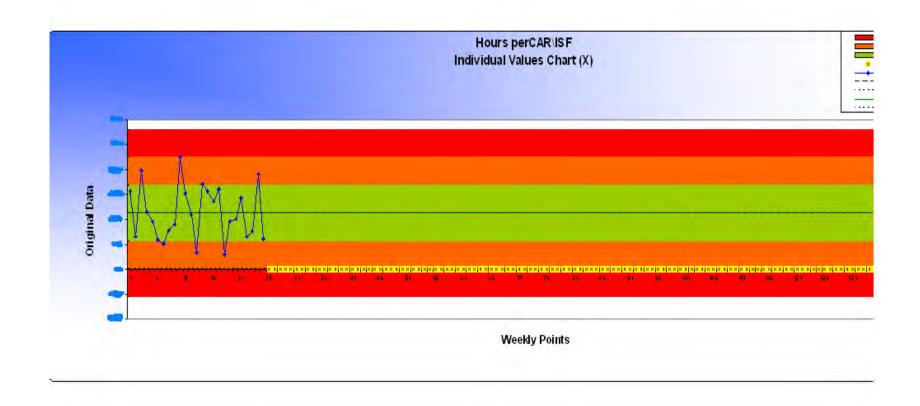
# Use a Quantitative Approach



# Keep an Eye on Things



## **Data Collection**





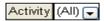




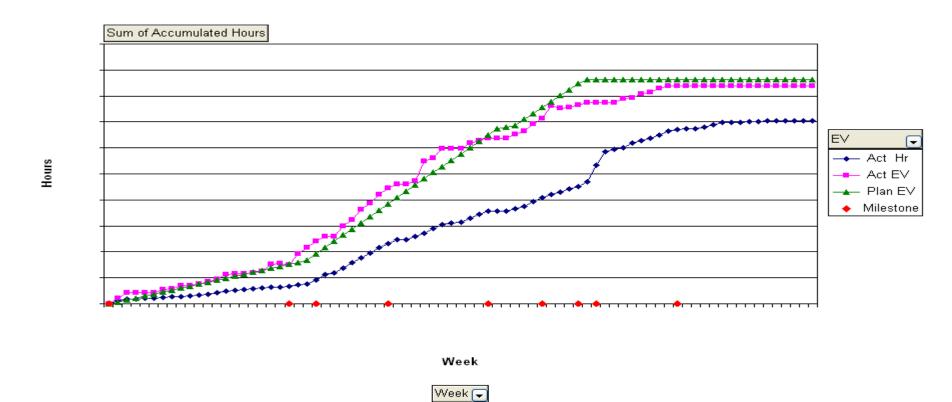


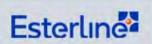


## **Data Collection**



Earned Value - Accumulated Hours (AVISTA Quality Program: Job 03 - Scampi A 2010)











# Measurement = Key



# Reappraisal Success!



# **Data Results**

Total Cost – 18% below projected budget

Schedule – Started one week earlier than anticipated

Mapping Cost – Increased by 1%

Added one additional appraisal team member Time per Appraisal member decreased by 18%

Reappraised as CMMI Level 5







# Don't Delay



# Questions?

### **Contact Info:**

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Process Improvement Manager
Esterline Control Systems - AVISTA
Phone (608) 348-8815
Email Craig.Hale@esterline.com
www.esterline.com/controlsystems/avista









# NDIA CMMI Conference 2010: Navigating the Waters of Reappraisal

- Gather lessons learned from key SCAMPI players in your organization
- Gather pre-SCAMPI data from your organization. No data? Start collecting!
  - o Improvement initiatives
  - Mapping Activities
  - o SCAMPIC, B, A
- Consistent appraisal team lead, and utilize them for 'Intro to CMMI' and other SEI courses
- Consistent key team members for appraisal team
- Utilize mini teams
- Utilize a tool to capture evidence and notes (could be as simple as a spreadsheet or database)
- Develop a model based on historical SCAMPI related activities to estimate
- Develop a company-specific CMMI interpretation guide
- Execute pre-SCAMPI activities as a project
  - Utilize DAR to determine what projects to use
  - o Utilize risk management to monitor the projects scope and schedule
  - Have a kickoff with projects involved, and have projects provide a high-level overview of project
  - o Develop an earned value (EV) plan
  - Perform quantitative management of pre-SCAMPI activities
  - Monitor and control
    - Performance to EV plan
    - XmR chart performance, when appropriate
  - Have stand up meetings
  - Hold program reviews with team and sponsors
  - Collect improvement suggestions through out
  - o Hold a project close out to identify what worked well
- Develop an action item tracking spreadsheet to track any evidence questions while mapping
- Hold working meeting with projects in appraisal to answer evidence questions and share information found in mapping sessions
- Plan for a gap analysis a few months prior to scheduled SCAMPI A
- Continually improve!

Esterline Control Systems – AVISTA Craig Hale, Process Improvement Manager Craig.Hale@esterline.com 608-348-1048



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# Process Performance Models for Hardware Engineers

# **CMMI Technology Conference**

November 15-18

#### Tom Fosness

Mechanical Systems Engineering Process Improvement Lead
Northrop Grumman Corp., Electronic Systems Sector
Rolling Meadows



# First a Brief Story...

Work Product Inspection Error Density Analysis

High Maturity???

Error Prediction and Removal Process-Performance Model

> Equivalent Effort Source Lines of Code



# **Drawing Normalization**



- Kind of drawing
- Number of Sheets
- Lines of Notes
- Drawing Originator
- Drawing Complexity

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### The Goals of this Presentation



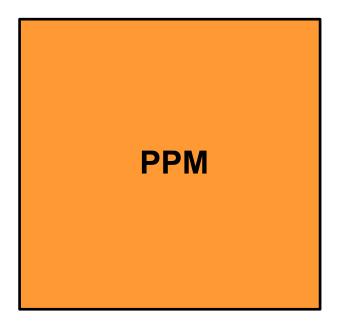
#### Goals

- Give hardware engineers an idea of where to start when devising PPMs
- Provide some guidance on developing PPMs
- Teach tactics and techniques that hardware engineers can put directly to use

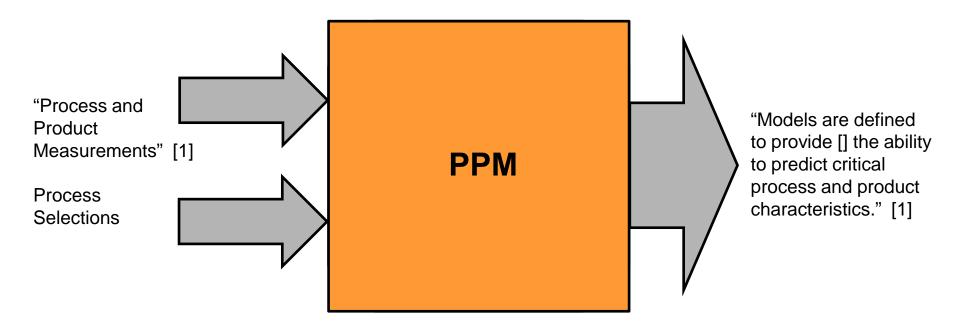
### Agenda

- General guidance on PPMs
- Look at common hardware development processes and identify some aspects that lend themselves to modeling
- Identify what we want to predict and what measures and baselines are needed to establish a model
- Look at some modeling techniques and some examples of hardware PPMs used at Northrop Grumman Electronic Systems, Rolling Meadows
- Talk about the value and potential benefits of these models

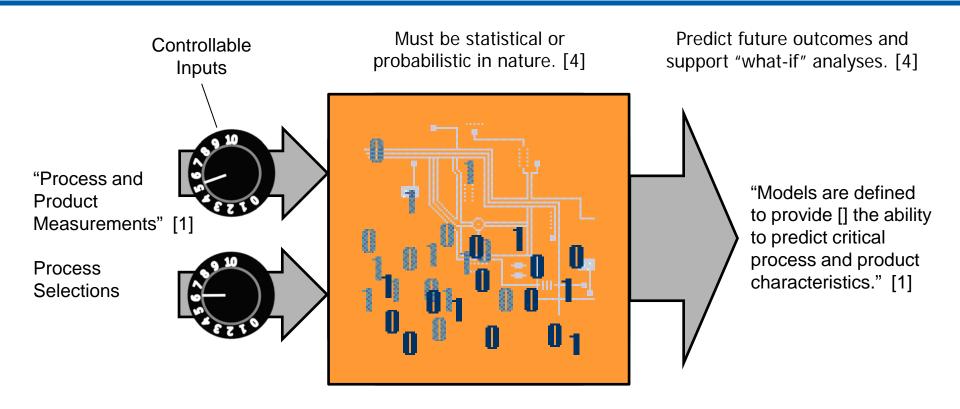




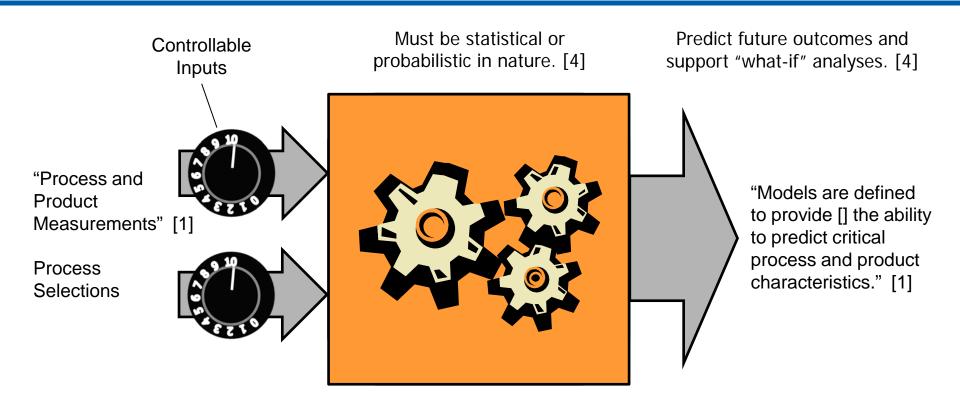




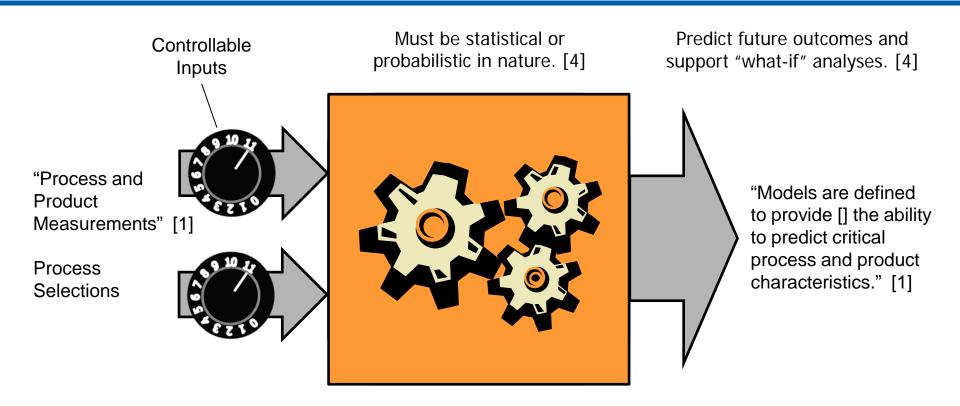










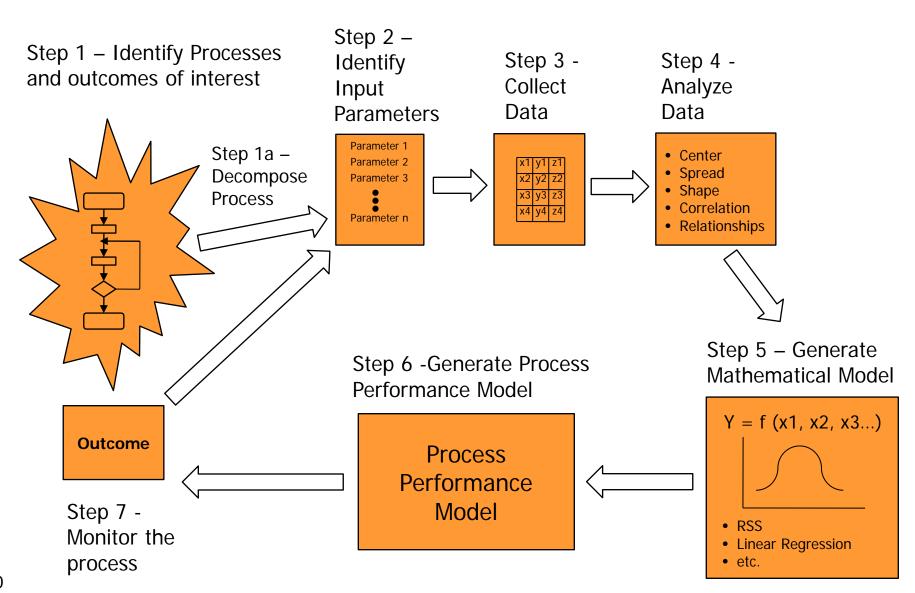


#### PPM Uses:

- Predict Process or Product Characteristics
- Evaluate the impact of process composition
- Evaluate the impact of processes measurements on performance relative to objectives

## Process Performance Model Development





## What do Hardware Engineers Do?



#### Requirements Development

**REQM** 

- Customer Requirements
- Product Requirements
- Analyze and Validate



Requirements Review

#### **Technical Solution**

- Select Component Solutions
- Develop the Design
- Implement the Design



Critical Design Review

#### **Product Integration**

- Prepare for Integration
- Ensure Interface Compatibility
- Assemble and Deliver



Test Readiness Review

#### **Verification**

- Prepare for Verification
- Perform Peer Reviews
- Verify Selected Work Products

**VAL** 

[1]

# What do Hardware Engineers Do? (Translation)



#### Requirements Development

**REQM** 

- Customer Requirements
- Derived Requirements
- Conceptual Design



Requirements Review

#### **Technical Solution**

- Evaluate Design Alternatives
- Model, Analyze, Document
- Procure Hardware



Critical Design Review

#### **Product Integration**

- Assy Dwgs And Instructions
- Assembly Tolerance Analysis
- First-Build Support



Test Readiness Review

#### **Verification**

- Test Plan and Procedure
- Internal Design Reviews
- Verification / Qual. Testing

<u>VAL</u>



# What do Hardware Engineers Care About?





#### Hardware Requirements

- Size & Weight (Form)
- Interfaces (Fit)
- Performance (Function)
- Endurance (Environment & Mission Survivability)
- Reliability

#### **Quality Objectives**

Meet or Exceed Requirements
Minimize Size and Weight
Maximize Performance
Maximize Endurance
Maximize Reliability
Maximize Customer Satisfaction

#### **Guiding Design Principles**

- Design for Manufacture
- Design for Assembly
- Design for (Lifecycle) Cost
- Design for Quality
- Process-Driven Design (Consistent & Efficient)
- Customer Focused Design

Process-Performance Objectives
Minimize Manufacturing Cost
Minimize Assembly Cost
Minimize Lifecycle Cost
Minimize Escaped Defects
Minimize Process Cycle Times
Maximize Customer Satisfaction





# Identifying Processes and Measures that Impact Key Characteristics



| 1                           |                  | Qu               | ality Charaر<br>لــــــــــــــــــــــــــــــــــــ | cteristics             | Process-Performance Characteristics |                |                  |                   |                    |                |  |  |  |
|-----------------------------|------------------|------------------|---|------------------------|-------------------------------------|----------------|------------------|-------------------|--------------------|----------------|--|--|--|
| Process Area                | Size &<br>Weight | Product<br>Perf. | Product<br>Endurance                                  | Product<br>Reliability | Customer<br>Satisfaction            | Manuf.<br>Cost | Assembly<br>Cost | Lifecycle<br>Cost | Escaped<br>Defects | Cycle<br>Times |  |  |  |
| Requirements<br>Development |                  |                  |   |                        |                                     |                |                  |                   |                    |                |  |  |  |
| Technical<br>Solutions      |                  |                  |   |                        |                                     |                |                  |                   |                    |                |  |  |  |
| Product<br>Integration      |                  |                  |   |                        |                                     |                |                  |                   |                    |                |  |  |  |
| Verification                |                  |                  |   |                        |                                     |                |                  |                   |                    |                |  |  |  |
| Modeling                    |                  |                  |   |                        |                                     |                |                  |                   |                    |                |  |  |  |
| Analysis                    |                  |                  |   |                        |                                     |                |                  |                   |                    |                |  |  |  |
| Doc / Drafting              |                  |                  |   |                        |                                     |                |                  |                   |                    |                |  |  |  |
| WPI                         |                  |                  |   |                        |                                     |                |                  |                   |                    |                |  |  |  |
| СМ                          |                  |                  |   |                        |                                     |                |                  |                   |                    |                |  |  |  |
| Drawing Revs                |                  |                  |   |                        |                                     |                |                  |                   |                    |                |  |  |  |
| Reviews                     |                  |                  |   |                        |                                     |                |                  |                   |                    |                |  |  |  |
| AI Resolution               |                  |                  |   |                        |                                     |                |                  |                   |                    |                |  |  |  |
| Procurement                 |                  |                  |   |                        |                                     |                |                  |                   |                    |                |  |  |  |
| Testing                     |                  |                  |   |                        |                                     |                |                  |                   |                    |                |  |  |  |
| Product                     |                  |                  |   |                        |                                     |                |                  |                   |                    |                |  |  |  |

### **Example Questions**



#### Requirements Development

- How will the vibration requirement affect the product development time and cost?
- How does the quantity of requirements affect the development time and cost?
- How does requirements maturity affect task on-time completions?

#### Technical Solutions

- How does analysis conservatism impact cost, schedule, quality? Test success?
- How does design time impact integration, test, manufacture, and assembly time?
- How do process selections to create prototypes and perform preliminary testing affect development cost?

### Product Integration

- How does standard part usage, design reuse, and other part selections affect procurement time?
- How does the tolerance stack method affect assembly quality?
- How does component testing affect assembly time?

#### Verification

- How does the level of testing affect product reliability?
- How does verification method (similarity, analysis, test) affect development cost?

# **Example Questions**

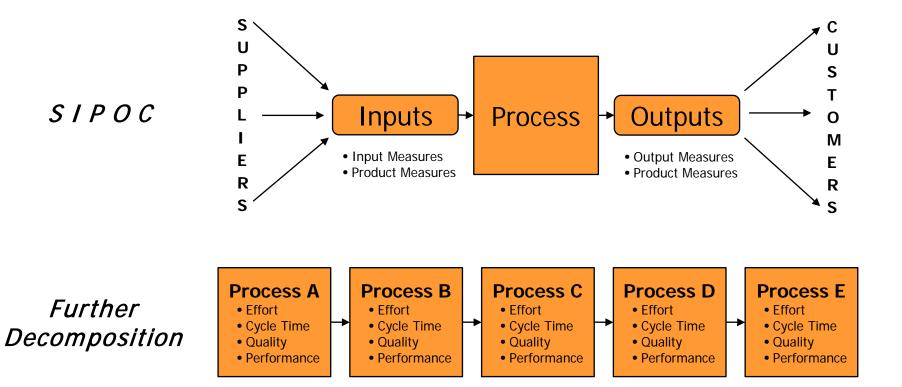


#### Product

- How does product complexity affect schedule, cost, and quality?
- How do Technical Performance Measures predict success/risk for the program?
- How does design decisions influence the manufacturing process?
- How does part count affect assembly time?

# Decomposing the Process and Identifying Input Parameters

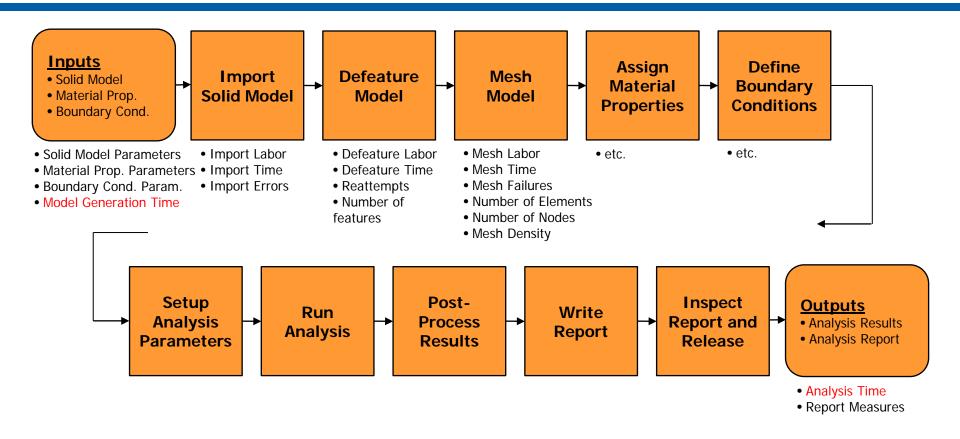




- Decompose until sub-process is measureable
- For each sub-process try to identify each of the following measures:
  - Effort Measure (labor hours)
  - Cycle Time Measure (schedule)
  - Quality Measure (errors / defects)
  - Performance Measure (yield / efficiency)

# Analysis Time Process Example





- For each subprocess identify measures that may contribute to the characteristic of interest
- Model may be dependent upon how one process or subprocess affects another

# How will one process affect another?



| \ Effect Cause \            | Requirements<br>Development   | Technical<br>Solutions  | Product<br>Integration  | Verification   |
|-----------------------------|---|---|---|--|
| Requirements<br>Development | <ul> <li>How does the<br/>quantity of<br/>requirements affect<br/>the requirements<br/>development time?</li> </ul> | <ul> <li>How will reqmts.</li> <li>affect analysis time?</li> <li>How does</li> <li>requirements</li> <li>maturity impact HW</li> <li>design time?</li> </ul> | <ul> <li>How will<br/>requirements affect<br/>assembly time?</li> </ul>   | <ul> <li>How does the<br/>quantity of<br/>requirements affect<br/>test cost and<br/>schedule?</li> </ul>                                 |
| Technical<br>Solutions      |   | <ul> <li>How does the<br/>drawing generation<br/>time and quantity of<br/>errors found affect<br/>procurement time?</li> </ul>                                | <ul> <li>How does the<br/>drawing generation<br/>time and quantity of<br/>errors found affect<br/>integration time?</li> </ul>  | <ul> <li>How does analysis<br/>time affect testing<br/>success?</li> <li>How does<br/>prototyping affect<br/>testing success?</li> </ul> |
| Product<br>Integrations     |   |   | <ul> <li>How does standard<br/>part usage, design<br/>reuse, and other part<br/>selections affect<br/>assembly time?</li> </ul> | <ul> <li>How does<br/>integration time<br/>impact system testing<br/>time and number of<br/>failures?</li> </ul>                         |
| Verification                |   |   | <ul> <li>How does<br/>component testing<br/>affect integration<br/>time?</li> </ul>   | <ul> <li>How do design<br/>review scores impact<br/>testing time?</li> </ul>   |

# Drawing Release Schedule (DRS) PPM



- Engineering drawings are a major work product for hardware engineering
- Once the design has been reviewed and deemed ready for procurement drawings are generated, inspected, and released to CM, in series
- Hardware procurement is dependent upon the timely release of drawings
- Engineering, Project Management, and Operations are interested to know when drawings will be released and to manage the Drawing Release Schedule

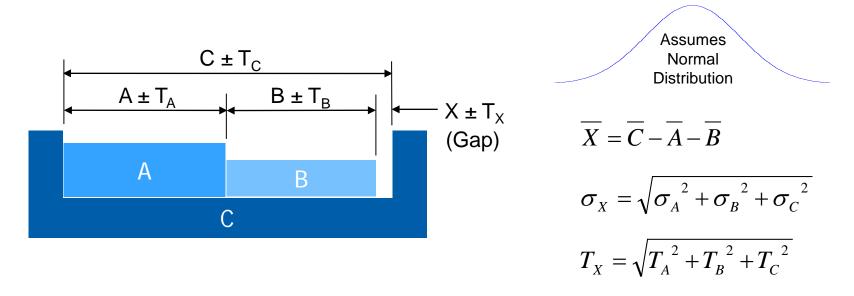


The DRS PPM forecasts when drawings will be completed and indicates when the schedule is off track

# Statistical Tolerance Stack Analysis



Lets begin with something familiar to mechanical engineers...

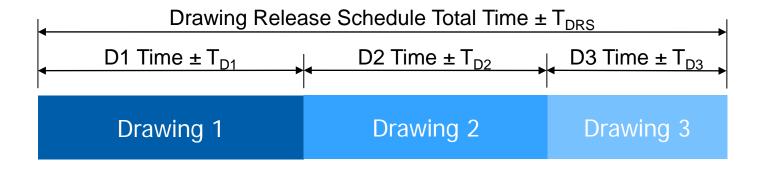


- Statistical Tolerance Stacking allows the designer to evaluate the effect part tolerances will have on critical interfaces of a higher level assembly. (Product attributes are used to predict product attributes.)
- How can a similar approach be used to predict process performance?

# Stack-Up PPMs



Method works well for time durations or labor hours summing in series



Drawing 1 + Drawing 2 + Drawing 3 = Drawing Release Schedule

Process A + Process B + Process C = Composed Process

Iteration 1 + Iteration 2 + Iteration 3 = Analysis Time

Test A + Test B + Test C = Total Test Time

CCA Design + PWB Layout + CCA Procurement Time

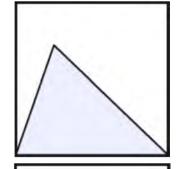
## What if the data is not Normal? (and it probably is not)



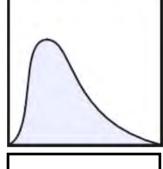




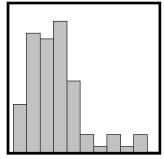
# Triangular Distribution



Beta Distribution



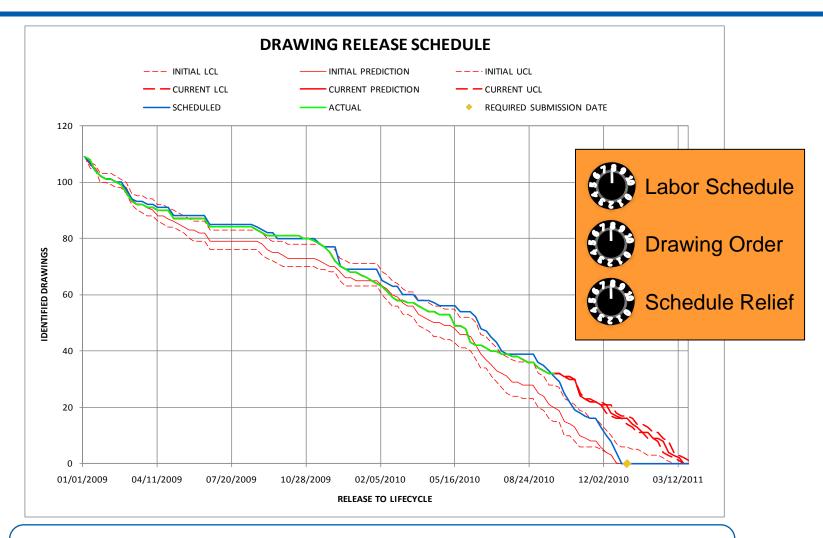
Histogram w/ Best Fit



- For a sufficiently large number of independent random variables that are identically distributed but not normal, the Central Limit Theorem states that the resulting summation is approximately normally distributed, allowing the RSS approach to remain valid.
   [6]
- Triangular or Beta distributions are commonly used for predicting time-based events. It is more likely that an event will exceed a predicted finish date than finish early (PERT - Program Evaluation Review Technique). [3]
- In the absence of historical data, a subject expert may predict the best-case, worst-case, and most likely case. [4]
- Better yet, Process Performance Baselines (PPBs)
   characterized using the mean and standard deviation and vetted
   for special causes can be fitted with a beta distribution, if
   appropriate.
- Alternatively, PPBs characterized using the median and fractiles can be fitted with a beta distribution based upon five or seven point estimates. This approach can be advantageous because fractiles are not significantly impacted by outliers. [5]
- Best of all, use Monte Carlo Simulation to predict a more exact output distribution from PPBs with a variety of input distributions.

# Drawing Release Schedule (DRS) PPM

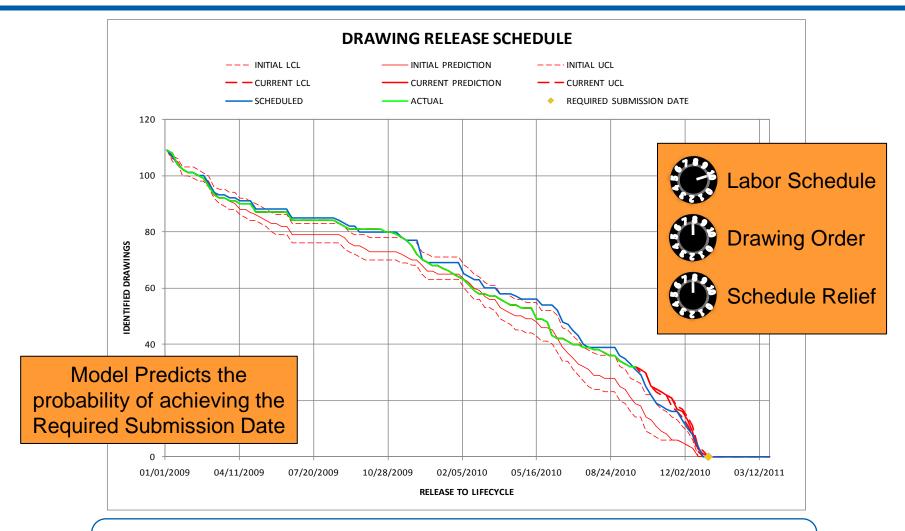




Model predicts DRS based upon statistical stack-up of drawing generation, review, and release cycle times.

# Drawing Release Schedule (DRS) PPM



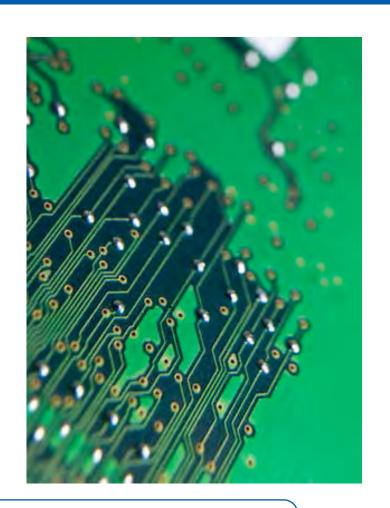


A violation of statistical limits invokes corrective action, typically an increase in devoted labor hours.

# Printed Wiring Board (PWB) Layout Labor Forecasting PPM



- The Design Layout Technology (DLT) group lays out where components will be placed on a Printed Wiring Board (PWB) and the layers, vias, and traces that will connect them
- Historically, the workload in this area has been difficult to manage (very up and down)
- DLT was interested in being able to predict their upcoming workload accurately based upon board complexities in order to adjust controllable factors and meet these demands.

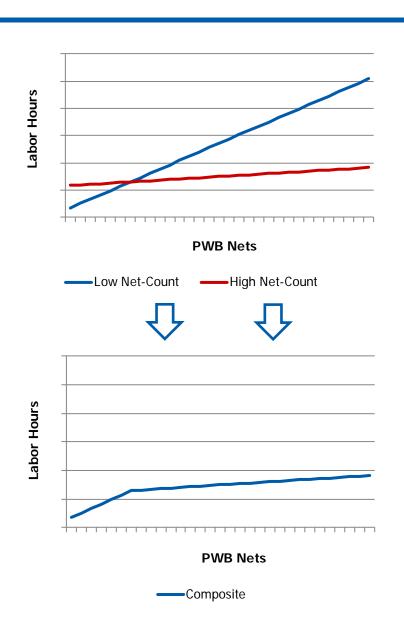


The PWB Layout PPM forecasts the workload for the DLT group and allows for the management of labor

### Generating a Linear Regression Model



- Complexity Factors
  - Component Count
  - Number of Nets
  - Number of Pins
  - Number of Vias
  - Number of Connections
  - Number of Vias per Connection
  - Number of PWB Layers
  - Number of Padstacks
- Strong correlation discovered between Labor Hours and PWB Net count
- Two-stage linear regression model established



# PWB Layout Labor Forecasting PPM

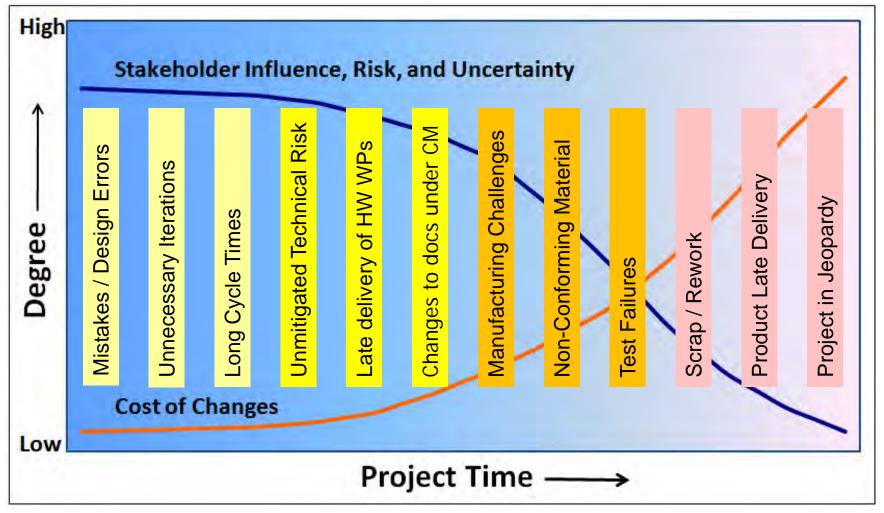
requirements for monitoring and control



| DWB Doc   | ian Labo                    | \r  |   |                                     |   |                                 |                                       |                                     |  |   |   |                             |        |         |        |        |        |        |
|---|-----------------------------|---|---|-------------------------------------|---|---------------------------------|---------------------------------------|-------------------------------------|--|---|---|-----------------------------|--------|---------|--------|--------|--------|--------|
| PWB Design Labor Prediction/Estimator Tool                      |                             | 95% Prediction Interval                         |   | Actuals                             |   |                                 | Proposed Handling of PWB Design       |                                     |  |   |   | Manpower Scheduling         |        |         |        |        |        |        |
| CCA Board   | Number<br>of Nets<br>w/Rats | Month<br>Scheduled<br>To Start<br>PWB<br>Design | Lower PWB Design Labor Prediction Limit (Hours) | Average PWB Design Labor Prediction | Upper PWB Design Labor Prediction Limit (Hours) | Actual PWB Design Labor (Hours) | Average<br>Predicted<br>Man<br>Months | No Special Handling<br>Start Design |  | Temporarily Hire<br>Contractor  | Reschedule Start Of PWB Design  | Comments                    | Sen-09 |         | Nov-09 |        |        | Feb-10 |
| months pesign (nouis) (nouis) (nouis) months                    |                             |   |   |                                     |   |                                 |                                       |                                     |  |   | DLT and PMO concur on labor<br>resolution, board not in critical<br>path, no special handling | <u> </u>                    | 000 00 | 1.07 00 | 200 00 | oun 10 | 100 10 |        |
| Overtime  Temporary Hire  |                             |   |   |                                     |   | Yes                             | No                                    | No /                                | No No  | required  | 1.29  |                             |        |         |        |        |        |        |
|   |                             |   |   |                                     |   | ,                               |                                       |                                     |  | DLT and PMO concur on labor<br>resolution, board not in critical<br>path, no special handling |   |                             |        |         |        |        |        |        |
|   |                             |   |   |                                     |   | re                              | Yes                                   | No/                                 | No   | No  | required DLT and PMOconcur on labor resolution, board is in critical                          | 1.60                        |        |         |        |        |        |        |
| 400   |                             |   |   |                                     |   |                                 | No/                                   | Yes                                 | No   | No  | path, special handling required  DLT and PMO concur on labor                                  |                             | 4      | 3.45    |        |        |        |        |
| Reschedule  |                             |   |   |                                     |   |                                 | /                                     |                                     |  |   | resolution, board is in critical path, special handling required                              |                             |        |         |        |        |        |        |
|   |                             |   |   |                                     |   |                                 |                                       | No                                  | Yes  | Yes   | No  | DLT and PMO concur on labor |        |         | 4.00   | 3.83   |        |        |
| DLT Labor Prediction PPM provides:                              |                             |   |   |                                     | Yes   | No                              | No                                    | No                                  | resolution, board not in critical path, no special handling required |   |   | 0.75                        | 0.76   |         |        |        |        |        |
| <ul> <li>Ability for Project and DLT organization to</li> </ul> |                             |   |   |                                     |   | No                              | Yes                                   | No                                  | No   | Prior direction provided to DLT for handling  |   |                             | 1.50   | 1.18    |        |        |        |        |
| control scheduling and costs for design of                      |                             |   |   |                                     |   | No                              | Yes                                   | No                                  | No   | Prior direction provided to DLT for handling  |   |                             | .,,,,  | 1.50    | 1.33   |        |        |        |
| PWBs  |                             |   |   |                                     |   | No                              | Yes                                   | Yes                                 | No   | Prior direction provided to DLT for handling  |   |                             |        | 1.00    | 1.27   |        |        |        |
| Ability to predict DLT labor requirements, as                   |                             |   |   |                                     |   | No                              | Yes                                   | No                                  | No   | DLT and PMO concur on labor resolution  |   |                             |        | 1.25    | 1.25   |        |        |        |
| well as prediction interval                                     |                             |   |   |                                     |   | INU                             | 165                                   | INO                                 | INU  | 16901011011   |   |                             |        | 1.23    | 1.23   |        |        |        |
| <ul> <li>Model allows for feedback of actual labor</li> </ul>   |                             |   |   |                                     |   |                                 |                                       |                                     |  | Total Number Of Man-Months  | 2.89  | 4                           | 9.7    | 9.52    | 3.85   | 0      |        |        |

# What do Hardware Engineers Care to Avoid?





http://leadinganswers.typepad.com/.a/6a00d834527c1469e20105368793e2970b-500wi

### Design for Manufacture and Assembly



- Often we think about manufacturing and assembly as production processes, but they are development processes as well
  - "Use effective methods to implement the product components" [1] (TS SP3.1, Subpractice 1)
  - "Assemble product components" [1] (PI SP3.2)
- Best practice advises that a component be designed with the manufacturing and assembly processes in mind
- It is the responsibility of the hardware engineer to consider manufacturing and assembly costs throughout the development process (the earlier the better!)
- Take advantage of process baselines from manufacturing focused process improvement initiatives, such as Six Sigma, Lean, and Total Quality Management, to devise Process Performance Models that offer insight into the development process.

| Taylor<br>Shewhart | Demming | Six Sigma ISO CMM | СММІ |
|--------------------|---------|-------------------|------|
| 1900               |         |                   | 2000 |

#### Considerations for a DFM PPM



 How do the manufacturing processes selected during the design phase affect the manufacturing cost?

#### **Joining**

- Welding
- Brazing
- Soldering
- Adhesive Bonding
- Press Fit
- Snap Fit
- Mechanical
- •Fastener
- Other

#### **Machining**

- Turning
- Forming
- Drilling
- MillingSawing & Filing
- Grinding
- Buffing & Polishing
- ECM, EDM, Laser
- Other

#### Casting

- Sand
- Shell Mold
- Plaster MoldCeramic Mold
- Investment
- Permanent Mold
- Die Casting
- Centrifugal
- Other

#### **Bulk Deformation**

- Rolling
- Drawing
- Extrusion
- Forging
- Other

#### Powder Metallurgy

#### **Sheet Metalworking**

- Shearing
- BendingSpinning
- Stretch Forming
- Deep Drawing
- Sheet Forming
- Press Forming
- Other

#### Polymer Processing

- Compression
- Molding
- Transfer Molding
- Injection Molding
- Rotational Molding
- Extrusion Molding
- Blow Molding
- Thermoforming
- Other

How do product and process parameters affect manufacturing process cost?

#### **Machining Cost Drivers**

- Volume of Material Removed
- Material Properties
- Tolerances
- Surface Roughness
- Number of Operations
- Number of Setups and/or Machines
- Part Size
- Number of Non-Standard Features
- Tool Clearance
- Access to Surface to be Machined
- Length of Tool Path

#### Plastic Injection Molding Cost Drivers

- Parting Line
- Number of Under-cuts
- Nominal Wall Thickness
- Draft
- Surface Finish
- Tolerances

[2] Stoll

A PPM predicting manufacturing process cost would depend upon process selections and product and process parameters

#### Considerations for a DFA PPM



How do product and process parameters affect assembly process cost?

Assembly 
$$Cost = \sum_{i=1}^{m} (C_H + C_I + C_S + C_A + C_V)_i + \sum_{j=1}^{n} (C_{SO} + C_V)_j$$

m = total number of parts or subassemblies

n = total number of separate operations

 $C_H$  = handling cost

 $C_{I}$  = insertion cost

 $C_S$  = securing cost

 $C_A$  = adjustment cost

 $C_V$  = verification cost

 $C_{SO}$  = separate operation cost

#### **Assembly Cost Drivers**

- Number of Parts
- Number of Fasteners
- Part Commonality
- Standard Part Usage
- Assembly Sequence
- Part Handling
- Part Insertion
- Part Securing
- AdjustmentsVerification
- Number of separate operations
- Tolerances

[2] Stoll

A PPM predicting assembly process cost would depend upon product and process cost driving parameters

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- [1] Chrissis, Mary Beth, Mike Konrad, and Sandy Shrum. *CMMI Second Edition Guidelines for Process Integration and Product Improvement*, Addison-Wesley, Boston, 2007.
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- [3] Gray, Clifford F., and Erik W. Larson. *Project Management The Managerial Process*, McGraw-Hill Irwin, Boston, 2008.
- [4] Software Engineering Institute, *Understanding CMMI High Maturity Practices*, Carnegie Mellon University, 2007.
- [5] Zhang, Yue. A simple and logical alternative for making PERT time estimates, IIE Transactions, 1996.
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### **Questions?**

### NORTHROP GRUMMAN

### Abstract – 35 minute presentation



- Looking for something a little more...hard-hitting? Well, this presentation
  is not for softies and it is guaranteed to hit close to home with hardware
  engineers. Learn tactics and techniques that hardware engineers can put
  directly to use.
- We will begin with a look at common hardware development processes and identify some aspects that lend themselves to modeling.
- Next, we will identify what we want to predict and what measures and baselines are needed to establish a model.
- We will look at some modeling techniques and some examples of hardware PPMs used at the Northrop Grumman Electronic Systems Rolling Meadows Campus, a CMMI Level 5 organization.
- Finally we will talk about the value and potential benefits of these models.
   Join us for a rock-solid approach to hardware process performance models.

## A Real-Life Example of Appraising and Interpreting CMMI<sup>®</sup> Services Maturity Level 2

#### **Neil Potter**

The Process Group help@processgroup.com www.processgroup.com

SM CMM Integration, IDEAL, and SCAMPI are service marks of Carnegie Mellon University.

<sup>®</sup> Capability Maturity Model, Capability Maturity Modeling, CMM, and CMMI are registered in the U.S. Patent and Trademark Office by Carnegie Mellon University.

### **Agenda**

- Introduction
- Applying Requirements Management (REQM) and traceability
- Applying Work Planning (WP) and Work Monitoring Control (WMC) to the operation of a services group
- The relation between Service Delivery and WP / WMC
- Size (attribute estimation)
- Which suppliers to apply Supplier Agreement Management (SAM) to?
- What is being audited for Process and Product Quality Assurance (PPQA)?
- How to apply Configuration Management (CM) to service artifacts
- Overlap between core and service PAs at Level 2
- Appraisal issues
- Reaction of a new group to the SVC model
- Suggestions to make life easier
- Summary

### Introduction -1





**Appraising** 

#### **Presenting:**

- Easy to gloss over all the sticky issues - "Look how good the service PAs are."

#### **Appraising:**

Sort out issues such as: core PA interpretation, overlap.

### Introduction -2

#### Appraisal team:

- Three people experienced with DEV (5-10 years) + LA (22 years with DEV)
- Used CMMI 1.2. (This presentation uses 1.3 text for clarity.)

#### Larger group:

- 200 people that design and build large airport baggage / parcel systems:
  - » Motors, steel, conveyors, electronics, software, installation, testing.

#### Groups appraised:

Bids/Proposals (7 people) and Financial services (11 people).





### Services Model v1.2 + 1.3 - Staged

| Level                       | Focus                                | Process Areas   | Quality        |
|-----------------------------|--------------------------------------|---|----------------|
| 5 Optimizing                | Continuous<br>Process<br>Improvement | Org. Performance Management Innevation & Deployment (OPM) Causal Analysis and Resolution (CAR)  | Productivity   |
| 4 Quantitatively<br>Managed | Quantitative<br>Management           | Organizational Process Performance (OPP) Quantitative Project Work Management (QWM)   |                |
| 3 Defined                   | Process<br>Standardization           | Capacity and Availability Management (CAM) (svc) Incident Resolution and Prevention (IRP) (svc) Service System Transition (SST) (svc) Service Continuity (SCON) (svc) Service System Development (SSD) (svc, optional) Strategic Service Management (STSM) (svc) Organizational Process Focus (OPF) Organizational Process Definition (OPD) Organizational Training (OT) Integrated Preject Work Management (IPM) Risk Management (RSKM) Decision Analysis and Resolution (DAR) |                |
| 2 Managed                   | Basic<br>Project<br>Management       | Service Delivery (SD) (svc) Requirements Management (REQM) Project Work Planning (WP) Project Work Monitoring and Control (WMC) Supplier Agreement Management (SAM) Measurement and Analysis (MA) Process and Product Quality Assurance (PPQA) Configuration Management (CM)  | Risk<br>Rework |
| 1 Initial                   |                                      |   | Rework         |

Based on SEI CMMI Services model www.processgroup.com v1.0

5

### **Applying REQM and Traceability**

The purpose of Requirements Management (REQM) is to manage requirements of products and product components and to ensure alignment between those requirements and the work plans and work products.

- REQM Takes A LOT of explaining to a non-familiar services group:
  - The services groups were bidding/tracking product requirements.
    - » Caused total confusion when they were left by themselves to read CMMI.
  - Requirements defined as group roles & responsibilities.
  - Initially we had to explain why REQM and SD are separate.
    - » Then we mapped REQM and SD together provide one front to the appraisal team and organization.
  - Too much GP!: Policy, plan, training, monitoring and auditing of roles & responsibilities definition activities?
    - » REQM might only take 1 day per year and 1 update every 6 months.
    - » The GPs need to be scaled down DRAMATICALLY to be useful OR mapped to SD GPs. We merged REQM and SD GPs.

### **Explaining REQM in the Appraisal**

- The appraisal team re-wrote the PA purpose for the final findings presentation:
  - The purpose of Requirements Management (REQM) is to manage requirements of products and product components and to ensure alignment between those requirements and the work plans and work products.
  - The purpose of Requirements Management (REQM) is to, a) define the services of the group, b) trace defined services to team activities, c) verify that resources, service definition and actual work done are aligned. [appraisal team definition]

### **Bidirectional Traceability (SP 1.4)**

SP 1.4 Maintain bidirectional traceability among requirements and work products.

"In a service environment, you should be able to trace stakeholder requirements to the elements of the delivered service and supporting service system that were developed from those requirements ......"

[CMMI 1.2 & 1.3]

#### Example 1

| SOX Requirement       | Implementation           | Test       |
|-----------------------|--------------------------|------------|
| SOX Annex - section 1 | Finance role 1, report 1 | SOX test 1 |
| SOX Annex - section 2 | Finance role 2, report 2 | SOX test 2 |
| SOX Annex - section 3 | Finance role 3, report 3 | SOX test 3 |

#### **Example 2**

| Bid Role<br>(defined in SLA) | Authority Level   | Tasks for Role                          |
|------------------------------|-------------------|---|
| Role 1                       | Approve up to \$X | Obtain estimates, define bid, check bid |
| Role 2                       | Approve up to \$Y | Tasks - role 2                          |
| Role 3                       | Approve up to \$Z | Tasks - role 3                          |

### **Applying WP and WMC**



- The group performs annual resource planning.
- "The plan" = Annual resource plan and service-event plan.
- Risks are assessed monthly:
  - E.g., Do we have resources to cover each bid / financial report?
- Schedules consist of bid and financial report deadlines.
- Stakeholders are defined on approval and signature sheets.
- Too much GP!: policy, plan, training, monitoring and auditing of annual and service-event planning?
  - Most planning events were a few hours in length.
  - We merged WP and WMC GPs.
  - Audits = signature approvals with checklists.



### Relation Between SD and WP / WMC



- In SD, planning (GP2.2) is used to plan the readiness and operation of a services group:
  - » SD GP2.2 Establish and maintain the plan for performing the process.
  - » SD GP2.3 Provide adequate resources for performing the process.....
  - » SD GP2.4 Assign responsibility and authority for performing the process......
  - » SD GP2.8 Monitor and control the process against the plan for performing the process and take appropriate corrective action.
- So what was WP / WMC used for?
  - Operations planning, of which service delivery is one significant aspect.
  - Annual resource planning and monthly resource tracking.
  - Special projects (non-trivial "other" work).

### Size (Attribute Estimation)

#### The group reads the practice:

- WP SP 1.3 Establish and maintain estimates of work product and task attributes.
- Add assumes that it is #Feet of steel, #motors.....etc.
- The bid group estimates the cost of a project:
  - #Feet of steel, #motors, #control panels, installation labor.



#### Luckily:

- Finance already had:
  - » Project categorization (the size/complexity of the project being financially tracked).
- Bids already had:
  - » Bid volume (#bid requests likely to arrive per month).

### Which Suppliers to Apply SAM to?

"The scope of this process area addresses the acquisition of products, services, and product and service components that can be delivered to the service's customer or included in a product or service system. This process area's practices can also be used for other purposes that benefit the service (e.g., purchasing consumables)."



- Both services teams had no suppliers:
  - An example would have been accounting experts, proposal writers.
- The product team had hundreds of suppliers; this was appraised under SAM in the DEV model.

Request

for bid

### What is Being Audited for PPQA?

#### Processes:

- Lifecycle and Service Delivery processes.
- Process Area processes.

#### Work products:

Service deliverables + critical internal documents.

### Processes audited via:

- Extensive Management Approvals.
- SOX audits.
- Corporate finance audits.
- ISO audits.
- Random quizzes.



#### Company Lifecycle



Monthly \$

### Documents audited via:

- Peer reviews using checklists.
- Signature approvals of document content.

### **How to Apply CM to Service Artifacts**

- Identify documents that service groups care about, e.g.,:
  - Internal: Annual plan, checklists, service agreement, audit results.
  - Deliverable: Requests, proposals, estimate sheets, contracts.
- Define directory structure for all documents, and plan for archival.
  - Merge Data Management plan in with CM.
- GPs keep them simple!
  - Someone assigned to set up the folders and access.
  - Task defined to "establish CM" that can be planned/tracked.
  - Team meetings for training, random audits for objective evaluation.



### Overlap Between Core and Service PAs

- Lots of overlap a MUST fix before appraising, otherwise:
  - You will be asking the same question 3-4 times.
  - The appraisal team will wear out.
  - The interviewees will think you are nuts and unsure about the model.

| Practice # | REQM Practice Definition   | Rewrite (Italics = exact copy of CMMI practice)  |
|------------|--|--|
|            |  |  |
| 1.1        | Develop an understanding with the requirements providers on the meaning of the requirements. | See SD sp1.2   |
| 1.2        | Obtain commitment to the requirements from participants.                                     | See SD sp1.2   |
| 1.3        | Manage changes to the requirements as they evolve.   | See SD sp1.2   |
| 1.4        | Maintain bidirectional traceability among requirements and work products.                    | Trace service requirements to downstream group activities and back (e.g., map service descriptions to team activities and deliverables; do we implement our service definition, do we exceed it, do we have gaps?) |
| 1.5        | Ensure that plans and work products remain aligned with requirements.                        | Align service definition, schedule/budget, team activities.  Examples:  * Does the services list state to do A, but in reality, the team is doing B.  * Analyze measurement, resource and service request data.    |

### Merging Some REQM Practices with SD

| Practice # | SD Practice Definition   | Rewrite (with additions from REQM SPs and GPs. Italics = exact copy of CMMI practice)   |
|------------|--|---|
| 1.1        | Analyze existing service agreements and service data to prepare for expected new agreements. | Analyze existing service agreements and service data. Use data as a basis for new agreements. What can we achieve based on the past - lessons; overlooked tasks?) |
|            |  | (e.g., In the past, what has been the sales volume, #bids that can be processed, timeliness.)   |
| 1.2        | Establish and maintain the service agreement.  | Define the services of the group and review with staff. [REQM sp 1.1].  |
|            |  | Obtain commitment to the services definition from the staff. [REQM sp 1.2]  |
|            |  | Establish and maintain the service agreements with customers.   |
|            |  | Manage changes to services (evaluate change).   |
|            |  |   |

### **Overlap (Continued)**

#### REQM (GPs)

| GP 2.1 | Establish and maintain an organizational policy for planning and | See SD GP 2.1 |
|--------|--|---------------|
|        | performing the process.  |               |
| GP 2.2 | Establish and maintain the plan for                              | See SD GP 2.2 |
|        | performing the process.  |               |
| GP 2.3 | Provide adequate resources for                                   | See SD GP 2.3 |
|        | performing the process, developing the                           |               |
|        | work products, and providing the                                 |               |
|        | services of the process.   |               |
| GP 2.4 | Assign responsibility and authority for                          | See SD GP 2.4 |
|        | performing the process, developing the                           |               |
|        | work products, and providing the                                 |               |
|        | services of the process.   |               |

| Praction | ce # WP Practice Definition                  | Rewrite (with additions from WMC GPs. Italics = exact copy of CMMI practice) |
|----------|--|--|
| 1.1      | Establish and maintain the service strategy. | Objectives: See MA sp1.1. Approach: See SD sp 2.1.                           |
|          |  | Risks: See WP sp 2.2.  |

### **Appraisal Issues**

- Asking CMMI questions to service professionals unfamiliar with CMMI:
  - Plan on rewriting (some of) the CORE PA practices, so that the interpretation is consistent and uses easier words.

| Practice # | CM Practice Definition   | Rewrite (Italics = exact copy of CMMI practice)   |
|------------|--|---|
| 1.1        | Identify the configuration items, components, and related work products to be placed under configuration management. | Define a list of items (files, contracts, bids, deliverables, documents) for the group that will be placed under control (e.g., version, access, backup). |
| 1.2        | Establish and maintain a configuration management and change management system for controlling work products.        | Establish and maintain a system (manual or automated) to store, manage and protect files on the list above.   |
| 1.3        | Create or release baselines for internal use and for delivery to the customer.                                       | Define naming conventions for files and documents, as they are created and released.  |
| 2.1        | Track change requests for the configuration items.   | Track changes made to files under CM control.  Example:  * Track changes in a history file or comment field of a version tool.                            |
| 2.2        | Control changes to the configuration items.  | Establish read/write access for files under CM control.   |

- Some service-specific practices need examples too:
  - e.g., "Maintain the service system" means?

### Reaction of New Group to the SVC Model

#### **Target audience reaction:**

- "How does this relate to our function?"
  - » "What are work product attributes," "What risks?," What are configuration items?" "What is a lifecycle?"
  - » Lead appraiser had to advise "don't read the model, it will just confuse you more." [specifically the core PAs]

#### Appraisal team reaction:

- Initially, total confusion:
  - » Reading the model, and memorizing what each practice means was wearing.
  - » "Model needs redoing," wording and overlap of practices.
  - » The findings of the class B appraisal acted as the new model definition for the team, along with the lead appraisers model rewrite.

#### The core PAs are the challenge

### Suggestions to Make Life Easier

- Run a (very) informal appraisal first, so that:
  - Interviewees have some idea of what your model interpretation is.
  - You can obtain experience asking interview questions and understanding the responses.



- Clarify terms (model glossary might / might not help\*):
  - "Requirement," "stakeholders in planning," "risk" vs. "issue," "traceability," "configuration item" "monitor the monitoring process."
- Train your team in the interpretation of the model before you appraise:
  - The SVC Supplement class doesn't cover the core PAs.
  - The Intro to CMMI SVC class doesn't cover overlap between PAs and the GPs in detail.

\*Requirement: (1) A condition or capability needed by an end user to solve a problem or achieve an objective. (2) A condition or capability that must be met or possessed by a product, service, product component, or service component to satisfy a supplier agreement, standard, specification, or other formally imposed documents. (3) A documented representation of a condition or capability as in (1) or (2).

### **Summary**

- The core Maturity 2 Level PAs CAN be used in a services organization. They do work.
  - An organization at ML2 is a more organized and efficient:
    - » E.g., #Mistakes, Response time, #Hours expended.
- The core PA practices are written for development, not for services.
  - Intro & Supplement classes focus on the benefit of the service PAs, not the difficulty interpreting the core PAs.
  - Plan on a rewrite, otherwise:
    - » a) You will have to explain practices every time.
    - » b) The target audience will probably forget the meaning and get totally off track.
- Define what services or work the PAs are being applied to.

### **Questions?**

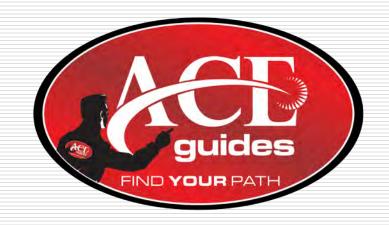
### **Acronyms**

- SOX Sarbanes Oxley
- SLA Service Level Agreement
- WP Work Planning
- WMP Work Monitoring and Control

I've got a SCAMPI A planned for a year from now,
I'm preparing for a SCAMPI B,
and here comes V1.3.
What should my evidence mapping (PIID) look like?

... PIID Strategies in a Changing Environment

Sam Fogle
SCAMPI High-Maturity Lead Appraiser
ACE Guides, LLC

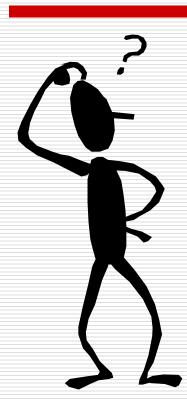


### Agenda

- SCAMPI V1.3 When and What?
- Data Collection? What's Involved?
- So, what do I build?
- Problems we have met & Lessons we have learned
- Got Any Tips?



# SCAMPI V1.3 - When and What?

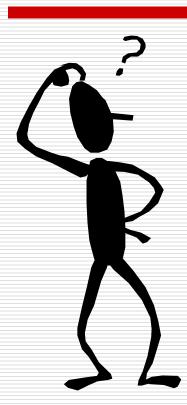


### V1.3

- SCAMPI V1.3 available Jan 2011
- SCAMPI V1.2 accepted until Nov 1, 2011
- Trying to cure "PIIDs Disease"
  - Establishing evidence types that don't lead to wasted work (e.g. distinction of direct/indirect)
  - Unambiguous rules/guidance for "enough?"
  - Efficient methods for collecting needed data
  - "Managed Discovery" mix of Ver. & Disc.
  - "Phased Data Collection" evolutionary



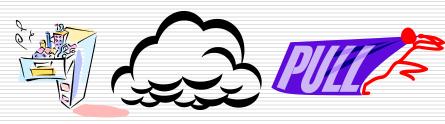
## Data Collection? What's Involved?



### Appraisal Terms and Concepts

- "To make reasonable judgments regarding an organization's implemented processes relative to the appraisal reference model, appraisal teams base their judgments on the collection of objective evidence for each specific and generic practice applicable to process area goals within the appraisal scope."\*
- Objective evidence or "footprints", left behind after a practice has been implemented, are Practice Implementation Indicators (PIIs).
- A mapping between model practices and the PIIs is called the Objective Evidence Database.

Full Discovery

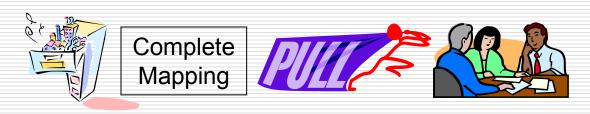


Full discovery requires that the team do a search for evidence for each practice

SCAMPI<sup>SM</sup> pilots took more than a month Appraisal conduct needed to be streamlined



2. Full Verification

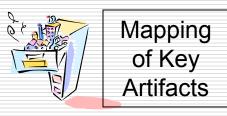


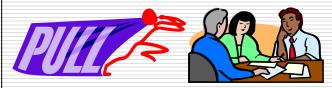
Full verification has the organization provide a mapping that indicates what evidence is appropriate for every practice. The appraisal team only needs to search when the data provided is not clear or convincing

An Objective Evidence Database could require >1000 hrs to develop

Appraisal preparation needed to be streamlined

Managed Discovery





Managed discovery has the organization provide key artifacts that address the majority of the practices and the appraisal team asks for additional evidence as required.

The appraisal conduct may require additional time but preparation is simplified



#### Comparison of the three approaches:

|                   | Preparation | Conduct  | Risk     |
|-------------------|-------------|----------|----------|
| Full Discovery    | Low         | High     | High     |
| Full Verification | High        | Low      | Low      |
| Managed Discovery | Moderate    | Moderate | Moderate |

SCAMPI V1.2 and V1.3 both allow all of the above or anywhere in between

It is up to the organization and lead appraiser to plan compatible preparation and conduct phases such that the organization's needs are best met.



## Data Types

V1.2

- Direct Evidence needed for every practice
- Indirect Evidence not necessarily for EVERY practice\*
- Affirmations
   not necessarily for EVERY
   practice\*

V1.3

Artifacts
 needed for every practice

Affirmations
 needed for every practice

\*Talk to your Lead Appraiser

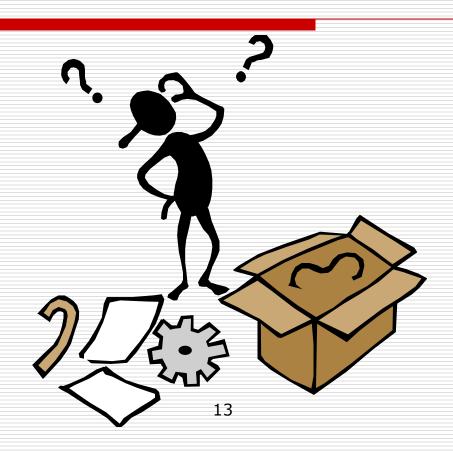


## An appropriate set of artifacts?

- Enough to convince the appraisal team that a practice has been fully implemented\*
  - Multiple instances for items that are produced frequently, e.g. meeting minutes
  - Cover the breadth of the practice



## So, what do I build?



## That's for you & your LA to decide

Balance your organization's resources and constraints

- What are your organization's priorities?
- What level of resources are available? (Including availability of CMMI and SCAMPI expertise)
- What level of risk is acceptable?

You will need to create some form of Objective Evidence Database or Mapping that relates CMMI practices to your data.



## Who should build your mapping?

What kind of knowledge is needed?

- Understanding of the model practices
- Understanding of the appraisal method
- Understanding of how the project's data is organized

Do you have one person with all 3? If not, then you need a team

- Process person?
- Project representative?
- Consultant?





## Mapping Contents

- CMMI<sup>®</sup> practice name
- Artifact name
- Artifact location
- Basic Unit (Project) or Support Group
- Comments (may explain relevance of data)

• ...



## Mapping format

- Does your Lead Appraiser have a tool that they recommend?
- Will you use the data for internal purposes?
- How easy is it to insert or retrieve data?
- How easy is it to correct/update the data?
- Will you map practices to artifacts or artifacts to practices?



## Cost & Timing

- Objective Evidence Database development can be a major driver of total appraisal cost
- The highest quality will come from developing the Objective Evidence Database in several iterations, so start early
- If it is possible to use the same sampling in a series of appraisals (B, then A), then going through the B will identify many of the Objective Evidence Database issues and allow corrections to the data collection process prior to the A.



## Validation

- Involve team members in quality checks
- Don't wait for Readiness Review to check the quality of the Objective Evidence Database
- Evolve mapping over a series of appraisals
- Effort devoted to the Objective Evidence
   Database (including quality checks) should be
   proportional to the importance of achieving
   the ratings

Remember: having an inaccurate mapping does not just make it harder to find the correct data, it may convince the appraisal team that appropriate data does NOT exist



## Problems we have met & Lessons we have learned



## Problems

 What sort of problems have you encountered in trying to plan for or develop your mappings?

 Have others encountered this same problem? And if so, were you able to solve it?

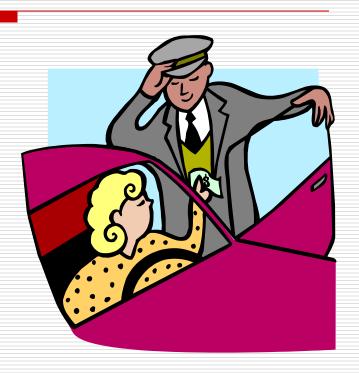


## Lessons Learned

 What other lessons have you learned related to Objective Evidence Databases?



## Got Any Tips?



## Potential Work Saver

Is the standard process detailed enough so that it will be fairly consistent between implementations where a specific type of data will be found?

Provide the units/projects with a mapping that already tells them where to find the evidence.

e.g.

PP SP 2.2 Identify Project Risks see section 3.4 of the Risk Management Plan



## Use Directories

- When the evidence you want to include is a frequently generated item (e.g. monthly meeting minutes or peer review reports) linking to the directory where the items are stored will provide advantages
  - The link will not go stale new items will continue to be populated into the directory so fresh evidence is available
  - The appraisal team is free to sample from the set, thus aiding confidence in institutionalization



## Mapping Preparation

#### If done poorly

- Can consume vast resources to prepare
- Will reflect a poor understanding of what is needed
- Will cause appraisal to proceed very slowly
- Can confuse the true state of the practice

#### If done well

- Will require limited restarts or rework
- Accurately reflects the work done in the organization
- Provides an efficient means for an appraisal team to find appropriate evidence
- Identifies appraisal risks by uncovering holes in implementation



# Questions



## Contact Info

- Sam Fogle, Chief Guide, SEI-Certified SCAMPI High-Maturity Lead Appraiser
- ACE Guides, LLC
- www.ACEguides.com
- sam@ACEguides.com
- 240-308-0767

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## Leaner SCAMPI SM Preparation

Gary Natwick
Harris Corporation
16 November 2010

NDIA CMMI® Conference and User Group

#### Providing Value To Our Customers





**Aviation electronics** 



Intelligence, surveillance, and reconnaissance



Space and ground satellite communications systems



Communications and information networks



**Operations and support services** 

#### People - Innovation - Process

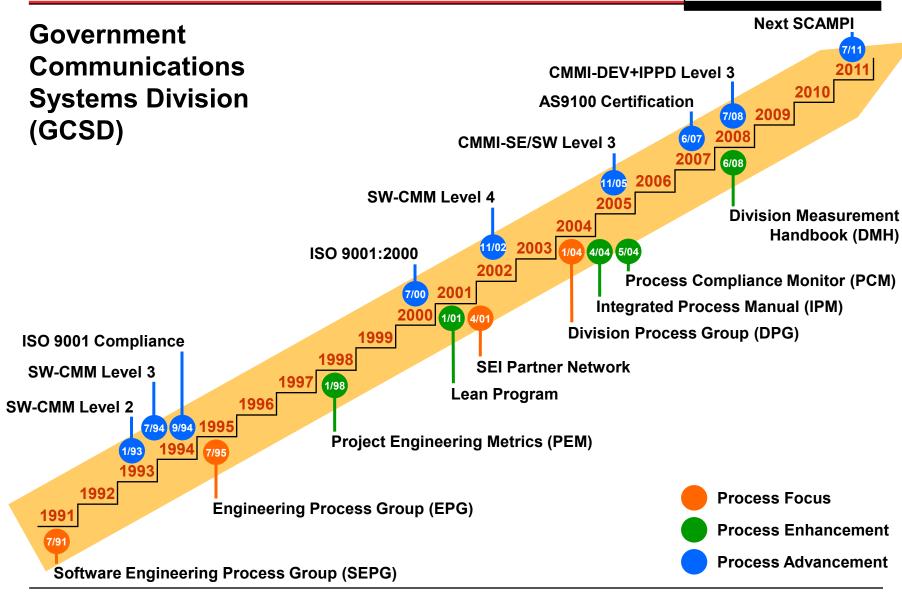
#### Agenda



- Background
- Challenge
- Approach
- Results
- Conclusion

#### Process Improvement Timeline





#### Background

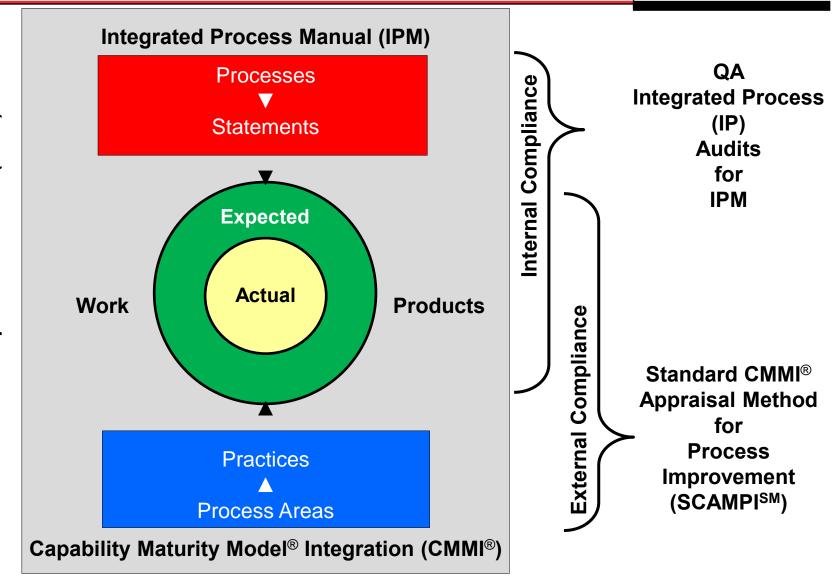


- Process Improvement is a learned skill
- To increase awareness and capabilities Harris is using a Lean Six Sigma approach
  - Encourage team members to look for ways to improve processes by
    - Quantifying the process
    - Recommending a change
    - Measuring the improvement
  - Teach skills to assist in the efforts
    - Lean Fundamentals eliminate waste
    - Simulation understand system performance
    - Change behavior people skills
    - Six Sigma tools mathematical skills

#### Organizational Process Context







#### Challenge



- Problem
  - Total cost of SCAMPI<sup>SM</sup> for division is significant and increases every SCAMPI<sup>SM</sup> cycle (3-years)
- Goals
  - Reduce SCAMPI<sup>SM</sup> preparation effort using Lean method
- Measurement
  - SCAMPI<sup>SM</sup> preparation effort
- Benefits
  - More efficient SCAMPI<sup>SM</sup> preparation process with earlier feedback for corrective actions

#### Approach



#### Objective

- Reduce effort in conversion for work products from internal organizational requirements to CMMI<sup>®</sup> Practices
- Establish a work product priority to focus on the number of CMMI® practices affected by each work product
- Reduce the rework in discovering the correct work product

#### Implementation

- Automate the conversion process
- Prioritized work product review
- Utilize process experts to data mine for work products
- Complete improvements prior to next SCAMPI<sup>SM</sup>
- Establish more detailed measurements of SCAMPI<sup>SM</sup> activities for future improvements

#### Validation

SCAMPI<sup>SM</sup>

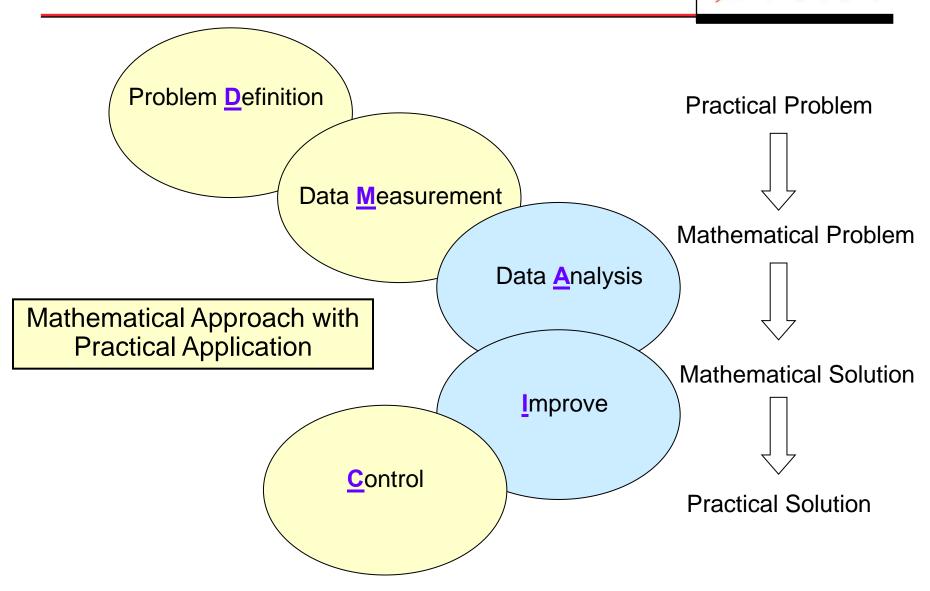
#### Lean Six Sigma



- A set of principles, concepts, and techniques designed to enable key processes to produce an optimum system that we'll deliver to our customers:
  - Exactly what they need
  - When they need it
  - In the quantity they need
  - In the right sequence
  - Without defects
  - And at the lowest possible cost

#### Six Sigma DMAIC Process







Define

Measure

Analyze

**Improve** 

Control

#### Supplier

- SCAMPI **Projects**
- Organizational (HR, DPG)

#### Input

- **SCAMPI Projects**
- **Program Work Products**
- Organizational Work **Products**

#### Process Process

- Characterize and reduce the frequency to review each work product
- Work products into PCM
- **Export from PCM** into Excel
- **Compare deltas** from last PCM export
- **CMMI®** conversion mapping macro
- Review & identify corrective actions
- Map corrective actions back to **PCM**

#### Output

- **Corrective Actions**
- CMMI® Progress Report

#### Customer

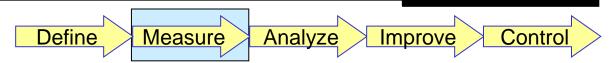
- **Program Team**
- Management
- Independent **Appraiser**

Export, conversion and mapping of work products is Non-Productive

Rework in discovering the correct work products is Non-Productive

#### Brainstorming



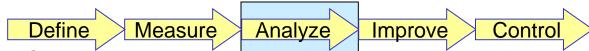


- Facilitated session with team resulting in 42 items
  - o Identified 3 possible Lean applications
    - Reduce effort in PCM to CMMI® conversion for projects work products
    - Establish a work product priority to focus on the items that typically have issues and minimize the amount of effort appraising
    - Reduce the frequency of discovering correct work products
  - No detailed measurement breakdown available from previous SCAMPI<sup>SM</sup> components or subparts
    - Planning
    - ✓ Preparation
      - ✓ PCM to CMMI® conversion
      - ✓ Discovery of work products
      - ☐ Review work products for corrective action
      - ✓ CMMI® to PCM conversion
    - Conduct
    - Closeout

Limited Historical Data to Demonstrate Measureable Improvement

#### Improvement Basis





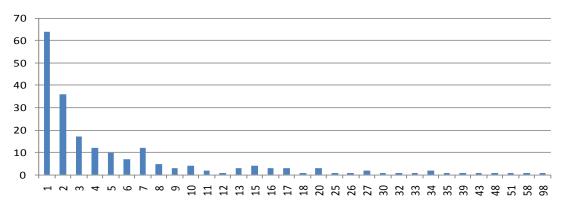
#### **PCM to CMMI Conversion**

 Sampled 4 months of SCAMPI<sup>SM</sup> effort for 2 individuals involved in conversion and applied 50% to represent best estimate of time spent
 Averaged 115 hours/month

#### **Work Product Priority**

 Analyzed the number of CMMI® practices affected by PCM default work products to prioritize

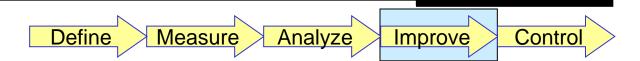




Sample to Establish Measureable Improvement

#### Improvement Approach



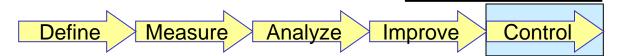


- PCM to CMMI® conversion for projects work products
  - Reduced to a one time event
  - Alternative communication used for corrective actions
- Establish a work product priority
  - Focus on the items that typically have issues and minimize the amount of effort appraising
- Find the correct work products the first time
  - Utilized process experts to data mining based upon standard organizational tools and standard program directory structure
  - Eliminated "bring me a rock"

#### Piloted on Next SCAMPISM Event

# Implement Process Controls





- Let's Not Do This Again
  - One time event for PCM to CMMI® conversion of projects work products
  - Establish a work product priority
  - Utilized process experts to data mining
- Setup work codes to measure SCAMPI<sup>SM</sup> activities for future improvements:
  - Planning
  - Preparation
  - Program Support
  - Reviews (Readiness & On-Site)
  - Closeout

Continuous Process Improvement

## Results



- Results through 1<sup>st</sup> SCAMPI<sup>SM</sup> Readiness Review compared to previous 2008 SCAMPI<sup>SM</sup> event
  - Preparation hours reduced by 59%
  - Cost reduced by 51%
  - Readiness of work products was improved
- Additional benefits
  - Reduced rework in discovering work products
  - Improved consistency in work products discovered across programs

## Conclusions



- Lean Six Sigma provides
  - Ability to look at things differently and question habits
  - Ability to look for ways to improve how we do business
  - Tools to enable facilitating change
    - People skills
    - Mathematical skills
    - Modeling skills
    - Increased awareness of available resources
  - Data to show it pays for itself!

## Contact Information



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## **Gary Natwick**

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- SEI-Certified Introduction to CMMI® Instructor
- Harris SEI Partner Business & Technical Point of Contact

<sup>&</sup>lt;sup>®</sup> CMMI is registered with the U.S. Patent and Trademark Office by Carnegie Mellon University. SM SCAMPI is a service mark of Carnegie Mellon University.

## Effectively Managing Process Compliance



# Agenda

- Current Challenges
- Goals
- Proposed Solution
- Tool Support and Interfaces
- Benefits

## **Current Challenges**

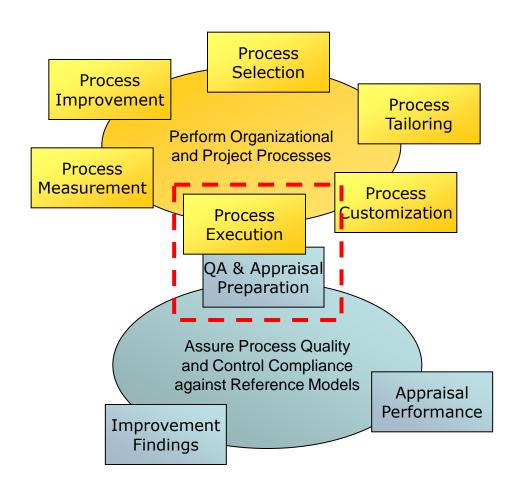
- Heavy time and cost pressure affects product quality
- Frequent audits or appraisals
- Up to 25% of work hours for audit preparation and performance
- Assure compliance with specific models or standards for safety, security, quality, reliability, etc. in parallel

## Goals

- Allow organizations to focus on the definition and implementation of processes
- Provide automated support to facilitate enactment of the processes
- Provide support for continuously monitoring adherence to the processes
- Support appraisal preparation and performance by automating evidence collection
- Effectively collect, manage and track non-conformances to closure in order to improve processes and secure future audit success

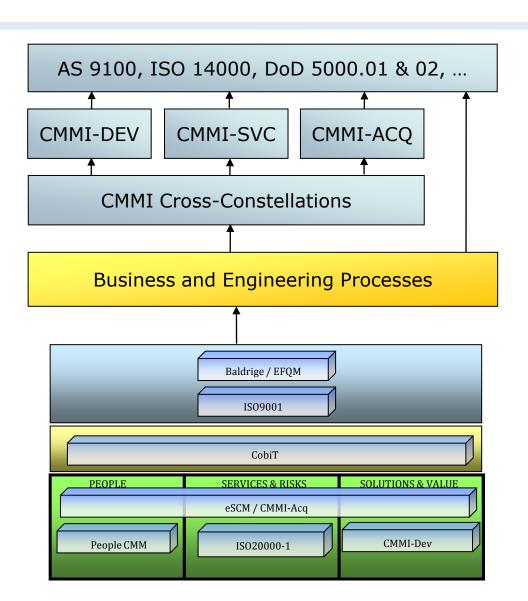
## Key Idea

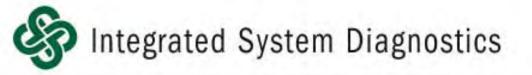
- Actively use the development processes in projects, i.e. by creating work products in projects
- Link the actively used development processes to the models or standards that need to be fulfilled (e.g. CMMI, ISO)
- Continuously perform PPQA activities
- Result: evidence data will automatically be collected in the background



## Multi-model Support

- Multiple reference models can be linked into multi-models
- Multimodel links are weighted
- Multimodels are specific to organization (i.e. dependent on type of business)





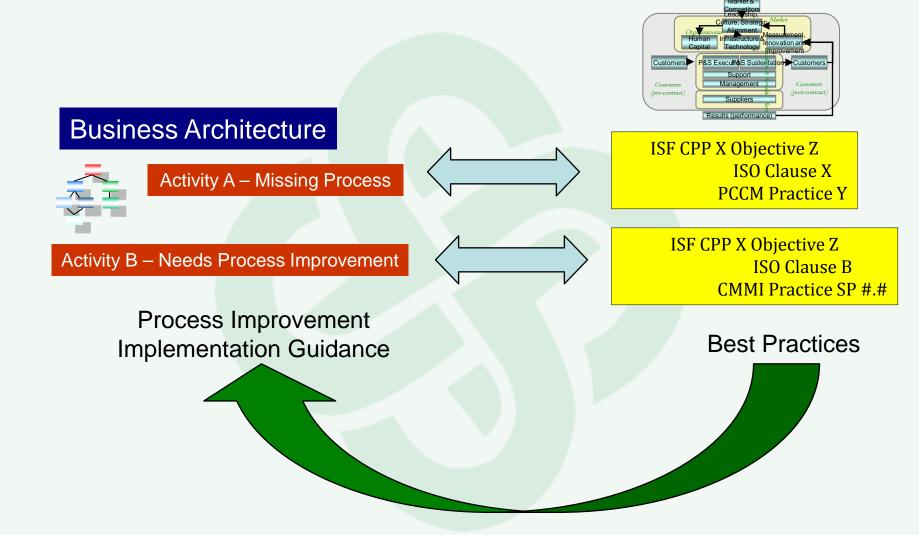
# **Process Composition and Definition**

- Establish and maintain Organization Standard Process model(s) in Model Wizard or Stages or tooling with similar capability.
  - Create or import a model of your enterprise processes that incorporates the desired best practices of applicable standards and model(s). Update when needed.
    - This step is performed once for each level at which the process is tailored within the enterprise. (e.g. Enterprise, Division, Department, Product Line)
    - Ultimately it is tailored to a particular project. At that point it becomes a representation of the Project's Defined Process.
    - It can then be used as the basis for identifying and analyzing information and evidence supporting:
      - Project QA activity and monitoring,
      - Internal compliance audits, and
      - External benchmarking appraisals or compliance audits.



## Relationship

## Enterprise Architecture, Best Practices, Process Improvement

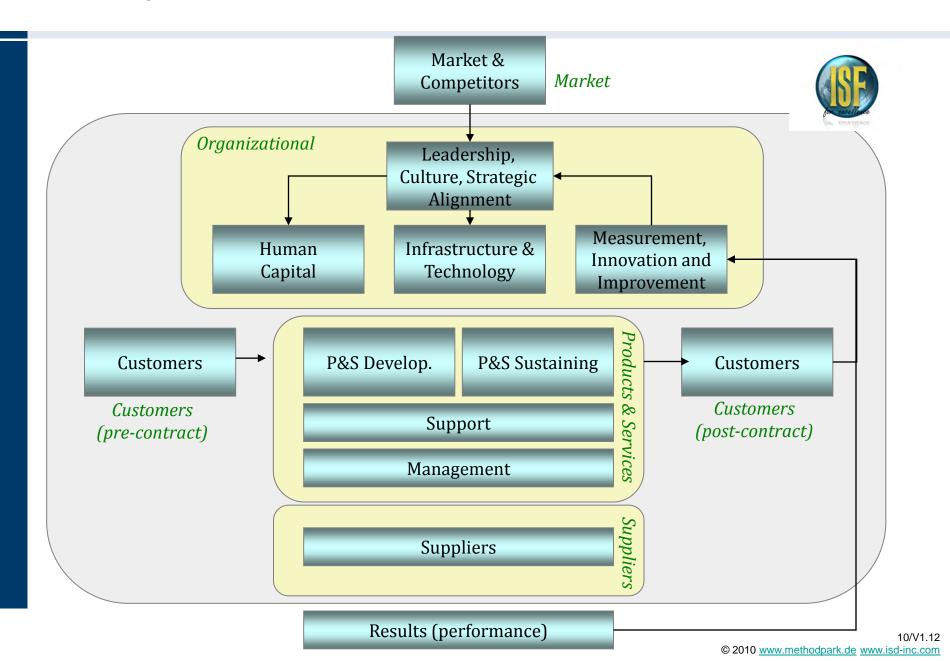




# Relationships: Process Architecture, Best Practices, Audits

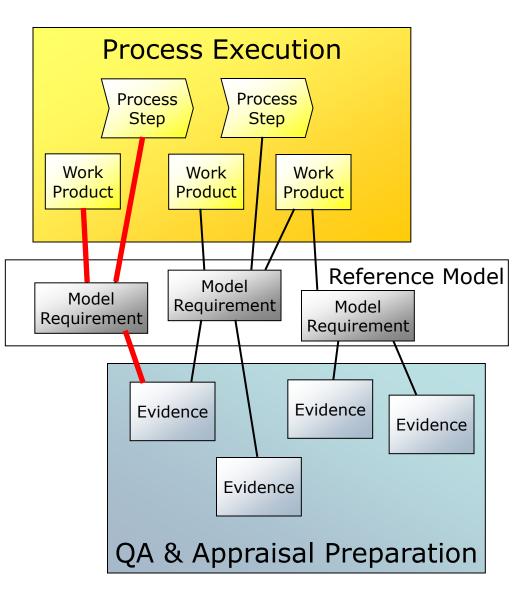
### **ISF** for Excellence **Integration / System Best Practices** Infrastructure & Innovation and Customers Customers Support Customers (post-contract) (pre-contract) **Process Definition Process Compliance Diagnostic Tools Customer Process Architecture** PPQA / Audit / Appraisal Findings Global Knowledge Management Solution End-to-End Delivery ISO Element Historida | Element Daoursons | Element Mapping | **Enterprise Appraisal** Support 0 Training Effectiveness CMMI primarily supports traditional software and engineering projects PO7 2 Personnel Competencies PO7 4 Personnel Training **eSCM** covers the entire spectrum of the contract sourcing lifecycle

# ISF for Excellence – Systemic View Integration Framework

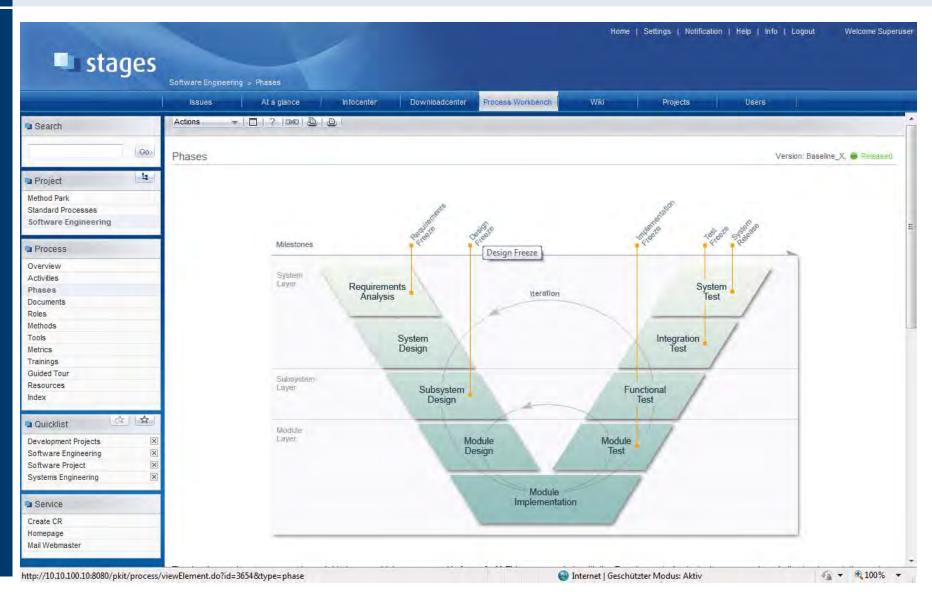


### Solution Details

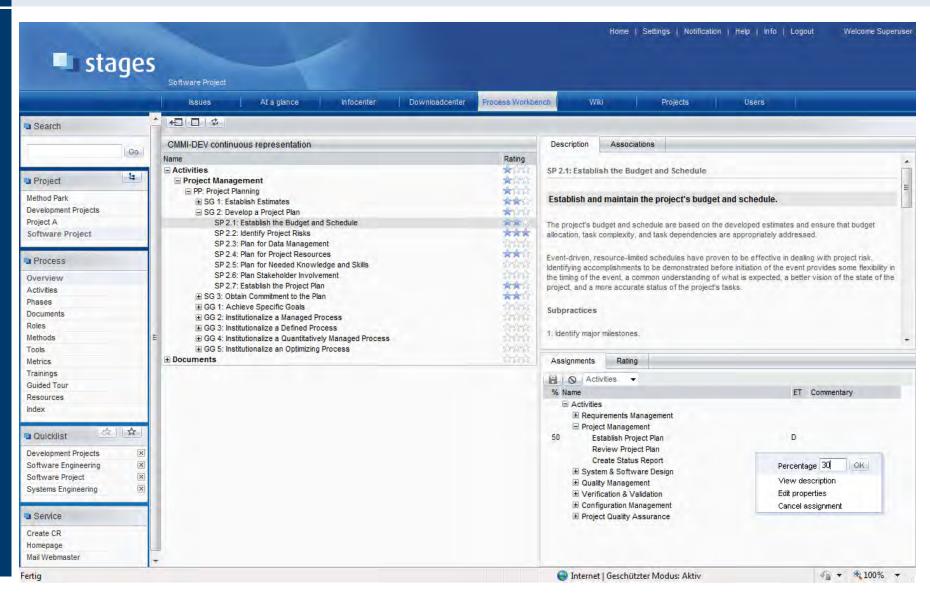
- Reference models are broken into different model requirements
- Process elements are linked with model requirements
- Model requirements are mapped to evidences
- Evidence data maps can be generated



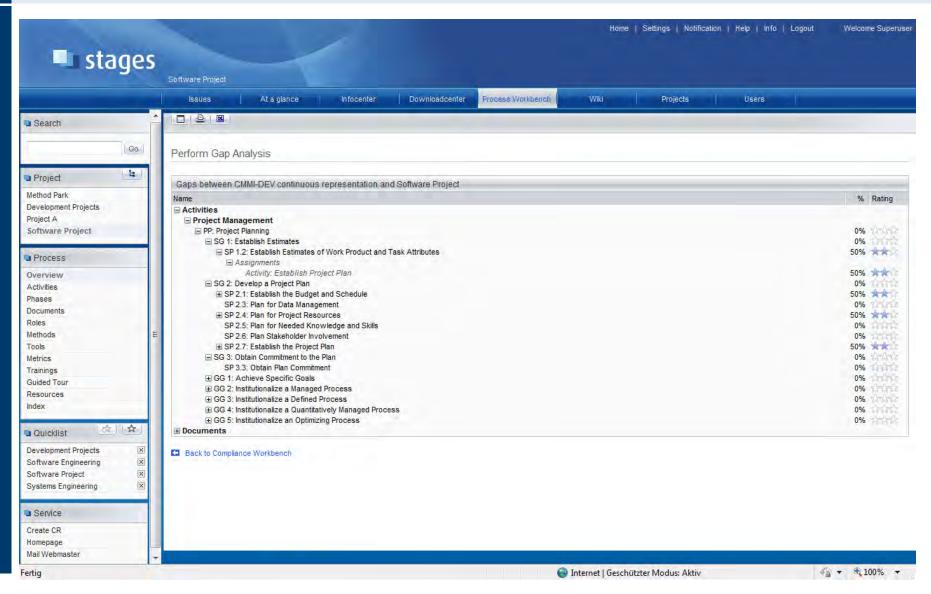
# Example: Process Lifecycle



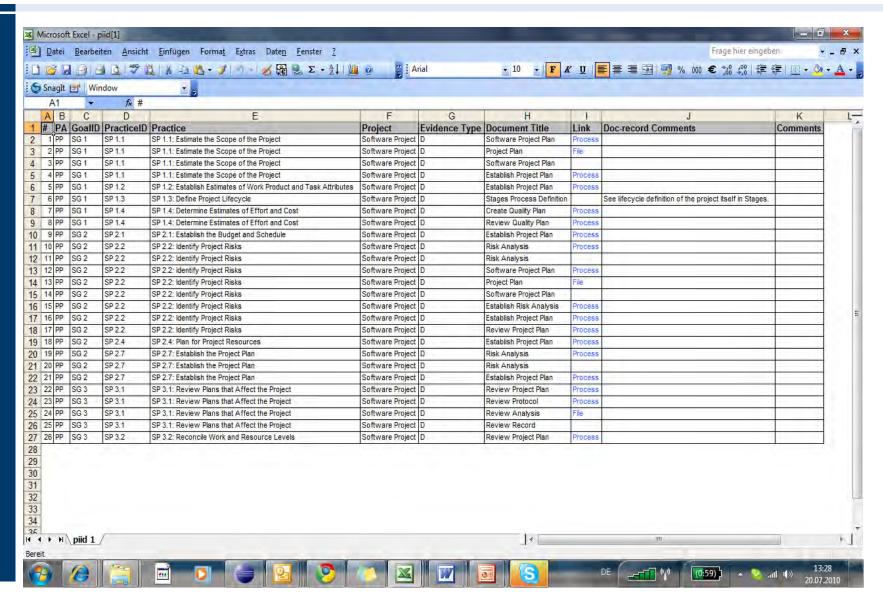
## Example: Process Compliance Mapping



## Example: Compliance Gap Analysis



## **Example: Evidence Data Generation**





# Integrated System Diagnostics

# **Audits and Appraisal Process**



Use **Model Wizard** to create or import a model that represents your Organizational Standard Model and/or the desired QA Reference Model.



12

Use **Appraisal Wizard (AW)** to setup Appraisal Wizard Audit Template(s) for each type of Audit you want to perform (e.g. setup unique record types, status values, and document types, etc.)



•Create Audit Question records to build audit checklist for set of audit checkpoints.

•Use the Record Documents tab and the document list to identify the expected objective evidence for each audit question. Use the AW tool during the audit to document the audit finding(s) (e.g. "Compliance, "Non-Compliance (N/C)", "Information Needed" record types).

- •Write up N/C Action Item records
- Determine compliance ratings



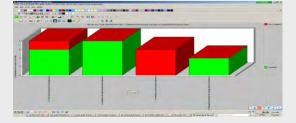




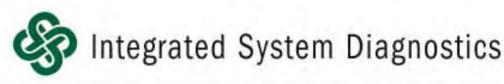
4

Use the AW tool to build various reports of the audit finding(s) (e.g. Reports of % compliant/% non-compliant findings; List N/C Action Items; etc.) to prepare for follow-on audits.

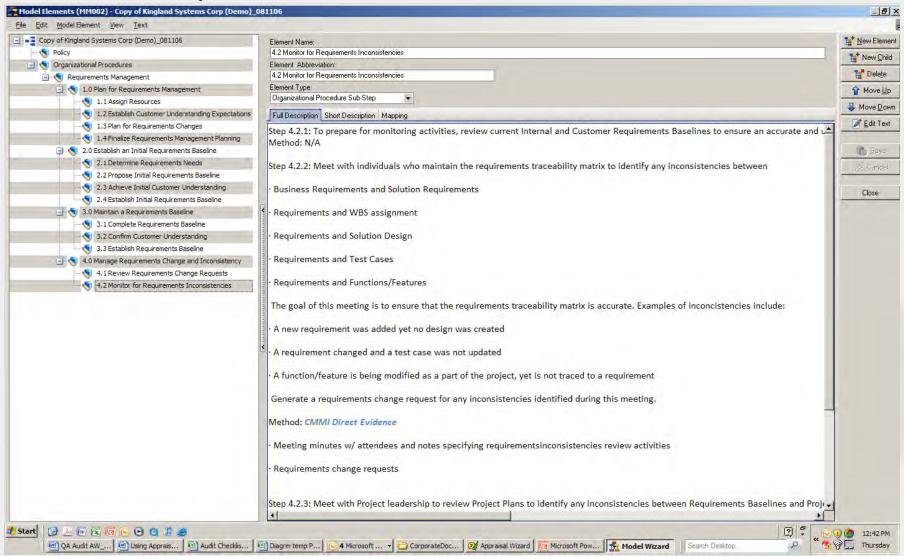


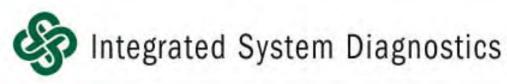


- •Use **Model Mapper** to map QA Reference model to a standard or model (e.g. CMMI) for use in appraisals.
- •Import new "Mapped Model" into AW to use audit results and organization's existing data to support Readiness Reviews and Appraisals.

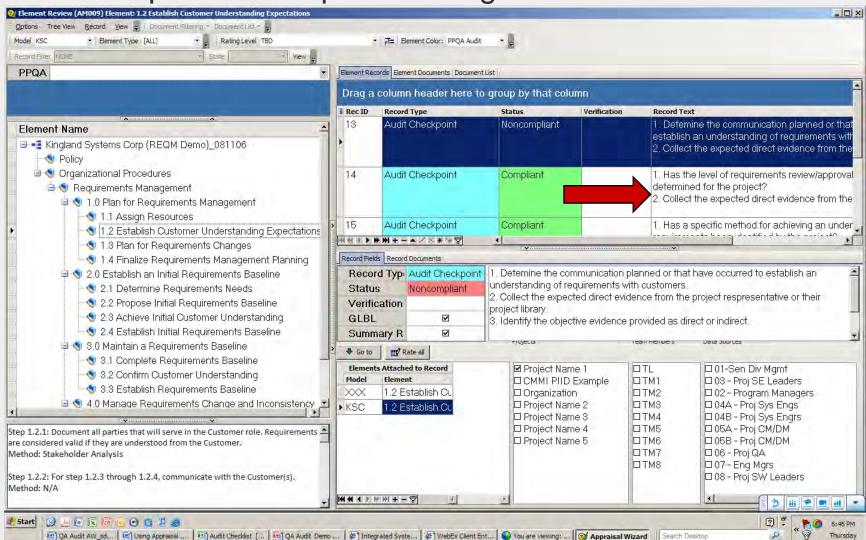


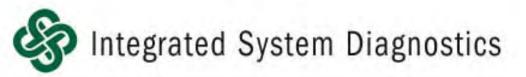
# QA Reference Model in Model Wizard



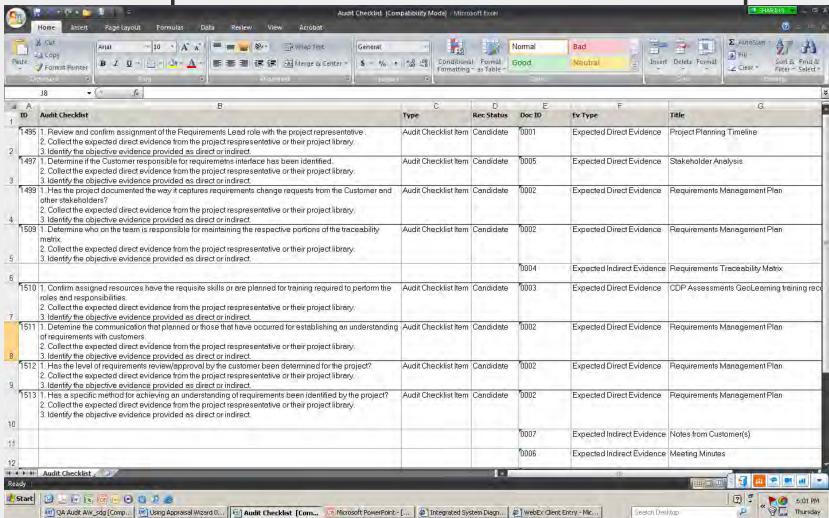


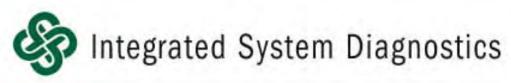
# Setup Audit Templates Using QA Reference Model



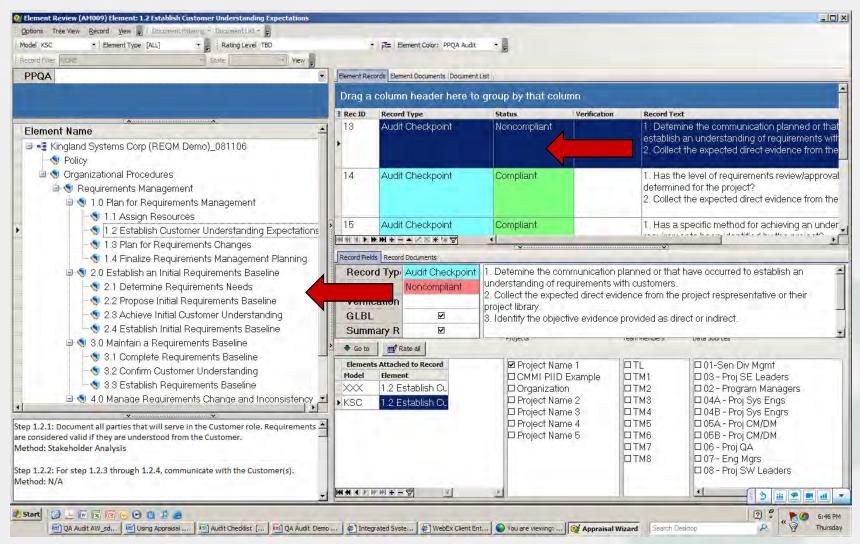


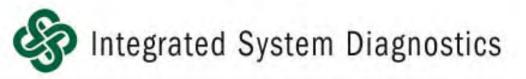
Audit Spreadsheet Generate and Re-import



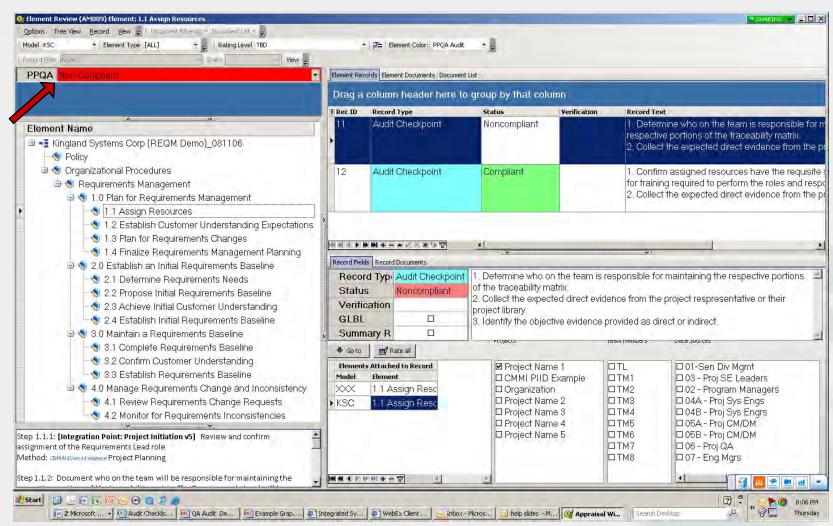


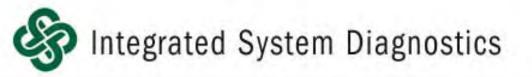
# Determine Status of Records/Documents



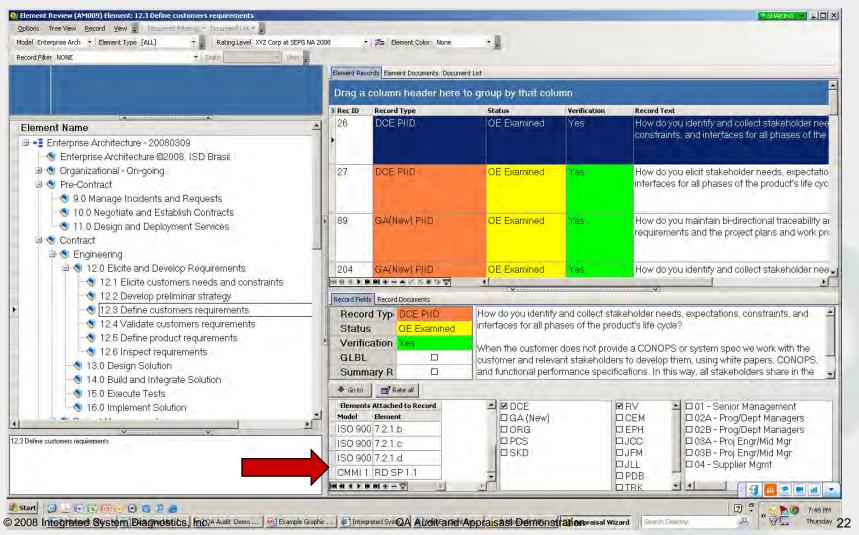


# Determine Element Compliance Ratings





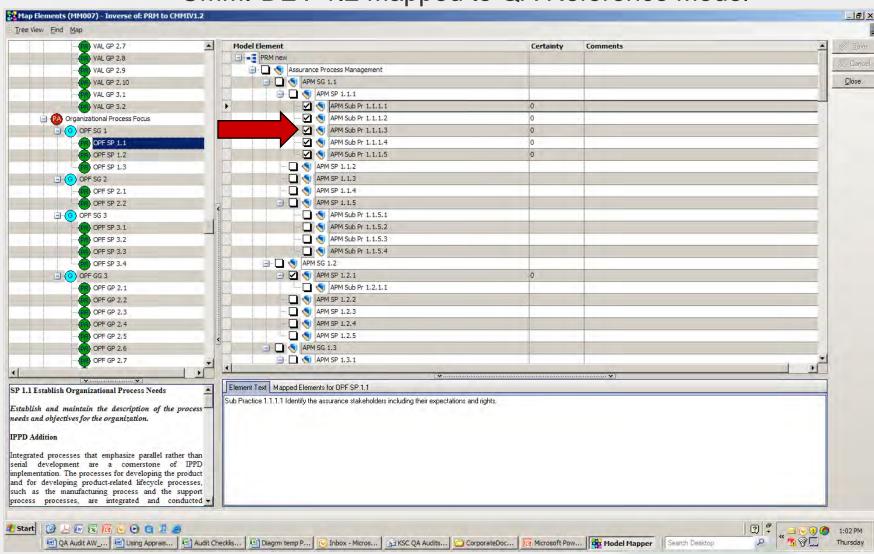
Audit Results and organization's existing data supports <u>appraisals</u> and ties to other standards/ models





# Integrated System Diagnostics

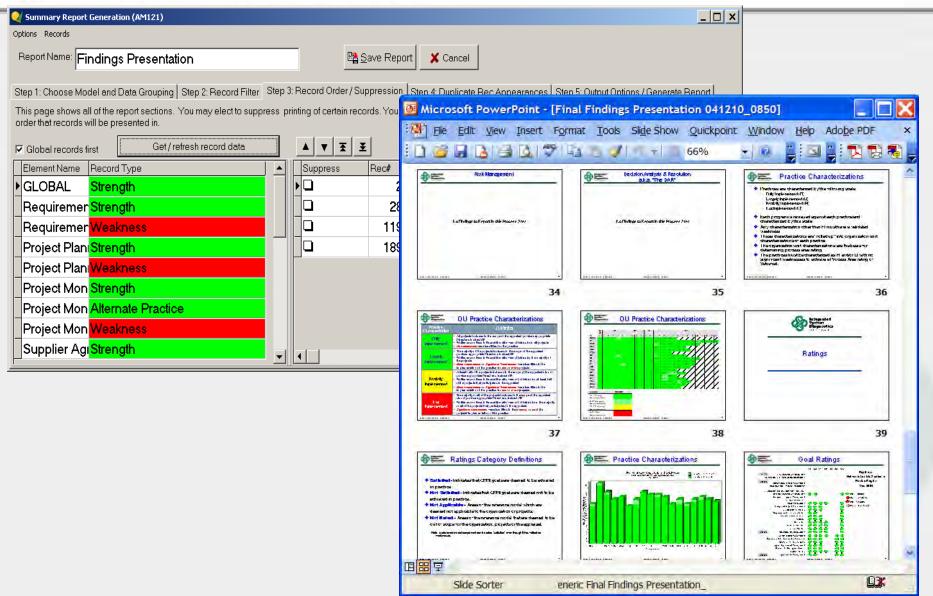
## CMMI-DEV 1.2 Mapped to QA Reference Model





# Integrated System Diagnostics

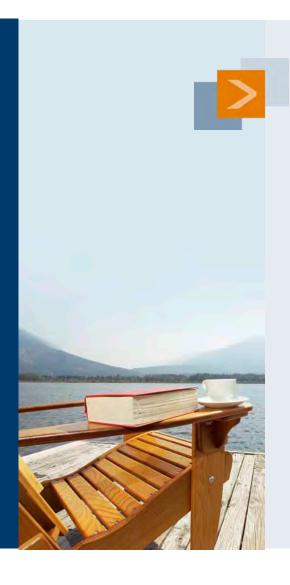
# **Generate Reports**



### Benefits

- Reduce complexity
  - Process descriptions become consistent and lean
  - No "CMMI or ISO speak"
  - Fulfill multiple standards in parallel
- Reduce efforts and costs
  - Companies reported up to 60% less efforts for audit preparations
  - No interruption of operational work because of audit preparations
- Concentrate on process improvement, not process administration





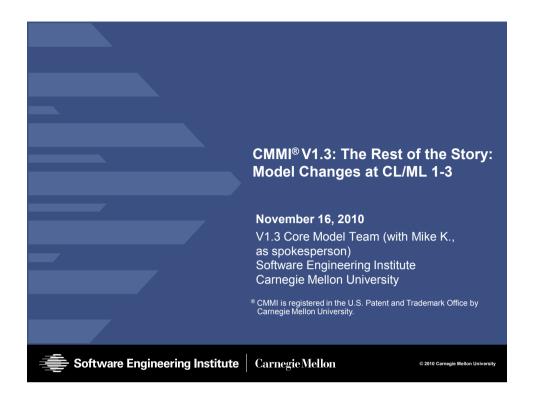
Thank you for your interest.

Visit websites <a href="http://www.isd-inc.com">http://stages.methodpark.com</a> and <a href="http://stages.methodpark.com">http://stages.methodpark.com</a>

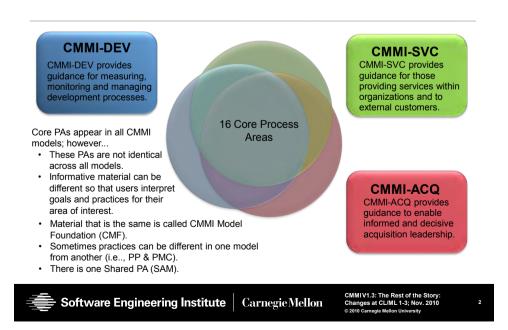
Download whitepaper from <a href="http://www.methodpark.com/en/resources/">http://www.methodpark.com/en/resources/</a>

Register for product trials at <a href="http://www.stagesAsAService.com">http://www.stagesAsAService.com</a>

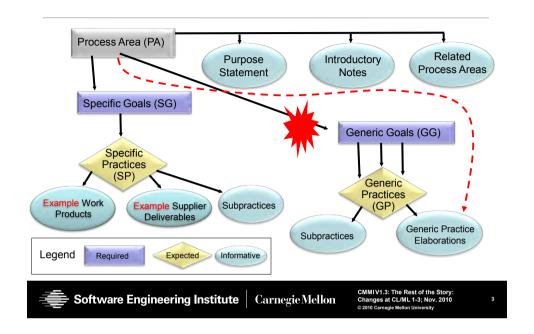
Request additional information at <a href="mailto:info@isd-inc.com">info@isd-inc.com</a> or <a href="mailto:info@methodpark.com">info@methodpark.com</a>



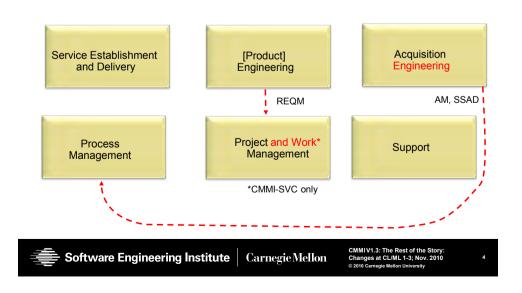
#### CMMI Models for Three Constellations



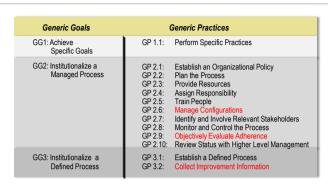
### **Process Area Components**



### **Continuous Representation: PAs by Categories** (And Potentially Across Constellations)



### **Summary of Generic Goals and Practices**



CL 4-5, GGs 4-5, GP 4.\* and GP 5.\*

CMMIV1.3: The Rest of the Story: Changes at CL/ML 1-3; Nov. 2010 Software Engineering Institute Carnegie Mellon

Adapted from

Cepeda Systems &

Software Analysis, Inc.

### Harmonizing V1.2 Models

#### The Problem

As V1.2 models were created and released, they became out of synch with one another. Improvements made in one model were not made in others simply because of differences in release schedules.

#### Overview of Solution

Analyzed differences among the three models (ACQ, DEV, SVC) to identify opportunities to improve all three while improving commonality. Examples of improvements include the following:

- GGs, GPs, and GP elaborations consolidated into one location (DEV)
- Improved measurement, supplier, and agreement terminology (DEV)
- Improved definitions of terms related to products and services (DEV, ACQ)
- Increased emphasis on customer satisfaction (all three)
- Improved examples, example work products, and notes (all three)

Many of the specific changes made to the model are due to harmonization and are covered in the PA Changes modules of Upgrade Training.



### Teaming Concepts<sub>1</sub>

#### The Problem

Teams are clearly relevant to product development. How teams are established in an organization has a lot to do with whether or not they are successful. However, there are no specific practices addressing rules for and establishing teams in DEV, instead there is the Integrated Process and Product Development (IPPD) addition, which is optional. Fewer than 5% of recent appraisals have included IPPD.

For acquisitions of complex systems, integrated teaming is not an option but a necessity. Thus, ACQ has, instead of an addition for IPPD, expected material that covers integrated teaming derived from generalizing and simplifying the IPPD material in DEV.

SVC adopted the ACQ approach, but in many service contexts "integrated teams" were not the key differentiator for success and the concept also proved to be problematic in some contexts.

Thus to harmonize the models, a different approach was needed.



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CMMIV1.3: The Rest of the Story: Changes at CL/ML 1-3; Nov. 2010

### Teaming Concepts,

#### Overview of Solution

Replaced the concepts of integrated teaming and IPPD with a more general concept of teaming, thereby eliminating the IPPD addition and making the approach to teaming consistent in all three models (By making the three constellations common, teaming can be part of the CMF.)

Replaced the glossary definition of "integrated team" with a definition of "team"

In the glossary definition, placed emphasis on what enables superior team performance:

A team establishes and maintains a process that identifies roles, responsibilities, and interfaces; is sufficiently precise to enable the team to measure, manage, and improve their work performance; and enables the team to make and defend their commitments.



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### The Term "Project",

#### The Problem

In V1.2 models, the word "project" was used in all three CMMI models, especially in the core process areas. "Project" was almost implicitly understood by product developers and acquirers.

However, service providers found it difficult to interpret goals and practices containing the word, often misinterpreted the models practices, and sometimes believed that model content containing the word "project" did not apply to them.

Although some users (probably familiar with development environments) could adjust, others had great difficulty and asked many questions.



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### The Term "Project" 2

#### **Overview of Solution**

Kept the word "project" in the DEV and ACQ models, but replaced it with alternate terms in the CMMI-SVC model. Depending on its implied meaning, the word "project" was generally either (1) simply removed, (2) replaced with the word "work," or (3) replaced with the word "work group."

These changes included changes to process area names (e.g., Project Planning becomes Work Planning). The process area category Project Management also became Project and Work Management.

Although the wording of some model material is different in SVC than in DEV and ACQ, if the only difference is the replacement of the word "project," the material is still considered CMF.

Added terms and revised definitions in the glossary that use the word "project" to ensure that the glossary more broadly fit all CMMI models.



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### The Term "Project",

#### Example – Process Area Content

#### **Project Planning (ACQ & DEV)**

Purpose: The purpose of Project Planning (PP) is to establish and maintain plans that define project activities.

#### SG 2 Develop a Project Plan

A project plan is established and maintained as the basis for managing the project.

#### Work Planning (SVC)

Purpose: The purpose of Work Planning (WP) is to establish and maintain plans that define work activities.

#### SG 2 Develop a Work Plan

A work plan is established and maintained as the basis for managing the work.



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### Core PAs: Support Category

#### Configuration Management

establish and maintain the integrity of work products using configuration identification, configuration control, configuration status accounting, and configuration audits

#### **Decision Analysis and Resolution**

analyze possible decisions using a formal evaluation process that evaluates identified alternatives against established criteria

#### Measurement and Analysis

develop and sustain a measurement capability used to support management information needs

#### Process and Product Quality Assurance

provide staff and management with objective insight into processes and associated work products

CM: Clarified that CM can apply to hardware, equipment, and other tangible assets.

DAR: Added guidance on preparing to use DAR practices and communicating results.

> MA: More clearly distinguished between information needs and objectives, measurement objectives, and business/project objectives. Included a table of examples (as in ACQ) for DEV and SVC.

Clarified that PPQA also applies to organization level activities and work products



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### **Core PAs: Process Management Category**

#### Organizational Process Definition

establish and maintain a usable set of organizational process assets, work environment standards, and rules and guidelines for teams

#### Organizational Process Focus

plan, implement, and deploy organizational process improvements based on a thorough understanding of current strengths and weaknesses of the organization's processes and process assets

#### Organizational Training

develop skills and knowledge of people so they can perform their roles effectively and efficiently

Converted goal on IPPD or Integrated Teaming to a single practice (IPPD no longer an addition)

Expanded applicability to training delivery methods such as self study, mentoring, and online training



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## **Core PAs: Project and Work Management** Category -1

#### Integrated Project Management

establish and manage the project and the involvement of relevant stakeholders according to an integrated and defined process that is tailored from the organization's set of standard processes

#### Project Monitoring and Control

provide an understanding of the project's progress so that appropriate corrective actions can be taken when the project's performance deviates significantly from the plan

#### Project Planning

establish and maintain plans that define project activities

Simplified SP 1.7 to replace work products, measures, and documented experiences" with process-related experiences.

Converted goal on IPPD or Integrated Teaming to a single practice (IPPD no longer an addition).

Added guidance for monitoring risks, data management, stakeholder involvement, project progress, and milestone reviews

Added guidance on determining project lifecycle and milestones.

Added subpractices on determining data rights and version control; and determining communication and other continuing resource needs



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## **Core PAs: Project and Work Management** Category -2

#### Requirements Management

manage requirements of the project's products and product components and to identify inconsistencies between those requirements and the project's plans and work products

#### Risk Management

identify potential problems before they occur so that risk-handling activities can be planned and invoked as needed across the life of the product or project to mitigate adverse impacts on achieving objectives

Changed the focus of SP 1.5 so that it now reads "Ensure that project plans and work products remain aligned with the requirements

> Included examples related to selected architecture, use of industry standards to identify risks, FMEA, and consequence monetization.

Provided guidance on maintaining risk parameters thru life of the project.



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### SAM – the Shared PA

#### SG 1: **Establish Supplier Agreements**

SP 1.1 **Determine Acquisition Type** 

SP 1.2 Select Suppliers

Establish Supplier Agreements SP 1.3

#### SG 2: Satisfy Supplier Agreements

SP 2.1 **Execute the Supplier Agreement** 

SP 2.2 Accept the Acquired Product

SP 2.3 **Ensure Transition of Products**  Clarified the applicability of SAM practices

Added the concept "products and processes of significant value to the project" to help determine what to monitor

Demoted SP 2.2 and SP 2.3 to subpractices of SP 2.1 and renumbered the remainder of the practices.

Revised SP 2.5 to allow its applicability to times when the product or service is delivered directly to the customer or end user from the supplier (SVC and DEV only).



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### **Principles of Architecture-Centric Practices**

- 1. Regardless of scale, architecture is the appropriate abstraction for reasoning about business/mission goal satisfaction.
- 2. Quality attributes have a dominant influence on a system's architecture.
- 3. Architectural prescriptions must be demonstrably satisfied by the implementation.



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### **Users Need Both Functions and Qualities**

Required capability

Low learning threshold

Ease of use

Predictable behavior

Dependable service

Timely response

Timely throughput

Protection from unintended intruders and viruses



Software system/mission goals should address user needs.

User needs often translate to quality attribute requirements.

Scenarios are a powerful way to characterize quality attributes and represent user and other stakeholder views.



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### **Modern Development Practices in CMMI - 1**

#### For Version 1.3, CMMI provides better guidance in support of architecturecentric practices

- creating the business case for the system (partially in RD)
- understanding the requirements (RD)
- creating and/or selecting the architecture (TS)
- documenting and communicating the architecture (RD, TS)
- analyzing or evaluating the architecture (RD, TS, VAL, VER)
- implementing the system based on the architecture (TS; A/PL notes)
- ensuring that the implementation conforms to the architecture (VER)
- evolving the architecture so that it continues to meet business and mission goals (implicit in the phrase "establish and maintain")

For a more detailed mapping of CMMI-DEV V1.3 to the above, see the slides from the half-day tutorial, "CMMI V1.3 and Architecture" (session 11203).



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## **Modern Development Practices in CMMI - 2**

## CMMI V1.3 provides improved terminology to support architecture-centric practices

- Updated the glossary to include new terms (and modified some old terms)
- Updated the informative material (especially ARD and ATM in ACQ; RD, TS, and VER in DEV; and SSD in SVC) to:
  - make use of the new terms
  - bring more emphasis to quality attributes and thus strike a better balance between functional and non-functional requirements
- Replaced selected uses of overloaded terms such as "performance" with an appropriate qualifying phrase.



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## Modernizing Development Practices<sub>3</sub>

#### Example - New terms reflecting modern engineering

#### quality attribute

A property of a product or service by which its quality will be judged by relevant stakeholders. Quality attributes are characterizable by some appropriate measure.

Quality attributes are non-functional, such as timeliness, throughput, responsiveness, security, modifiability, reliability, and usability. They have a significant influence on the architecture.



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## Modernizing Development Practices

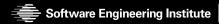
### Example – New terms reflecting modern engineering

#### architecture

The set of structures needed to reason about a product. These structures are comprised of elements, relations among them, and properties of both.

In a service context, the architecture is often applied to the service system.

Note that functionality is only one aspect of the product. Quality attributes, such as responsiveness, reliability, and security, are also important to reason about. Structures provide the means for highlighting different portions of the architecture. (See also "functional architecture.")



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### **Requirements Development**

| SG 1: Develo                            | op Customer Requirements  | Added that requirements can be   |  |
|---|---|--|--|
| SP 1.1                                  | Elicit Needs  | monitored through development  |  |
| SP 1.2                                  | Transform Stakeholder Needs into Customer Requirements                  | based on their <b>criticality to the customer</b> or end user.   |  |
| SG 2: Develop                           | Product Requirements  |  |  |
| SP 2.1                                  | Establish Product and Product Component Requirements                    | Revised the terminology used from a strong emphasis on "operational scenarios" to a more balanced  |  |
| SP 2.2                                  | Allocate Product Component Requirements                                 | "scenarios (operational, sustainment, and development)."   |  |
| SP 2.3                                  | Identify Interface Requirements   |  |  |
| SG 3: Analyze and Validate Requirements |   |  |  |
| SP 3.1                                  | Establish Operational Concepts and Scenarios                            |  |  |
| SP 3.2                                  | Establish a Definition of Required Functionality and Quality Attributes |  |  |
| SP 3.3                                  | Analyze Requirements  | Added 'quality attributes' as properties of products and services in addition to 'functionality,' which resulted in changes to SG3 and SP 3.2. |  |
| SP 3.4                                  | Analyze Requirements to Achieve Balance                                 |  |  |
| SP 3.5                                  | Validate Requirements   |  |  |



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## **Product Integration**

#### SG 1: Prepare for Product Integration Revised the purpose statement to ensure proper **behavior** instead of proper function, thereby including **quality attributes**. SP 1.1 Establish an Integration Strategy SP 1.2 Establish the Product Integration Environment SP 1.3 Establish Product Integration Procedures and Changed emphasis on integration sequence to an emphasis on Criteria integration strategy. SG 2: Ensure Interface Compatibility SP 2.1 Review Interface Descriptions for Described an integration strategy and how it relates to an integration Completeness SP 2.2 Manage Interfaces SG 3: Assemble Product Components and Deliver the Product SP 3.1 Confirm Readiness of Product Components for Integration SP 3.2 Assemble Product Components

**Evaluate Assembled Product Components** 

Package and Deliver the Product or Product



SP 3.3

SP 3.4

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Component

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## Addressing Agile<sub>1</sub>

#### The Problem

Developers that use Agile methods sometimes resist using CMMI because they can't see how CMMI practices can complement or improve the effectiveness of Agile methods.

#### **Overview of Solution**

Added guidance to the appropriate PAs to do the following:

- Help users interpret the practices in a context where Agile methods are
- Reinforce the applicability of the practices in an Agile environment
- Send the message that CMMI is a robust best practice framework meant to be used in Agile environments as well as other development environments



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## Addressing Agile,

#### Solution

Added a new section to DEV Chapter 5 entitled "Interpreting CMMI When Using Agile Approaches"

- This section describes how CMMI practices can apply in a variety of development environments. It also provides interpretive guidance in selected PAs that explains how the PA can be used in Agile environments.
- A reference to this new section appears in the SSD intro notes of SVC.

Added interpretive guidance to the following PAs:

- In DEV: CM, REQM, PP, RD, TS, PI, VER, PPQA, and RSKM
- · In ACQ: AM, ATM, PMC, and PP
- In SVC: SSD

Added in DEV and SVC (SSD only) Agile-related examples (as bullets)



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## Addressing Agile<sub>3</sub>

An example of a note added to DEV is the following one for PP:

"In Agile environments . . . Teams plan, monitor, and adjust plans during each iteration as often as it takes (e.g., daily). Commitments to plans are demonstrated when tasks are assigned and accepted during iteration planning, user stories are elaborated or estimated, and iterations are populated with tasks from a maintained backlog of work. (See "Interpreting CMMI When Using Agile Approaches" in Part I.)"



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## **Summary of Global Changes, CMMI Version 1.3**

Refining CMMI Framework Related

Terminology

Harmonizing V1.2 Models

Updating Model Architecture

**Process Related Experiences** 

Glossary

Teaming Concepts

The Term "Project"

Providing "Appropriate" Phrasing in Practice Statements

Generic Practices

Addressing Agile

Causal Analysis at Lower Levels of

Maturity

**Customer Satisfaction** 

Modernizing Development Practices

Prioritized Customer Requirements

Organization-Level Contracts

**Easing Translation** 

Front Matter

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## Questions





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# **Benefits of CMMI Within the Defense Industry**

Software Engineering Institute Carnegie Mellon University Pittsburgh, PA 15213

May 2010

## **Outline**



- Introduction
- Benefits of CMMI Implementation
  - Quantitative
  - Qualitative
- Perspectives on CMMI Adoption
- Appraisal Trends 2010
- Looking Ahead
- Summary

This report was created with the cooperation of the Systems Engineering Division (SED) of the National Defense Industrial Association (NDIA) and their member companies and DoD organizations.

## **Purpose of Presentation**



## Present new evidence about effective implementations of CMMI

- Examples are provided by the defense industrial base and DoD organizations.
- New examples are based upon the measures that practicing organizations use to track value to their businesses.
- Examples are provided by organizations that have tracked and measured performance improvements from using CMMI over many years.
- Many of the organizations emphasize high maturity results and show that they enabled superior performance.
- Their data indicate why CMMI is important to the DoD & its suppliers.

The new data presented in this report demonstrates that effective implementation of good practices aided by use of CMMI can improve cost, schedule, and quality performance.

## **CMMI: Major Benefits to DoD**



"Does CMMI work?" We asked our nation's defense contractors, as well as government agencies, to share results from their performance improvement efforts using CMMI. The results spoke for themselves: "Yes, CMMI works!"

The following slides include information from six defense organizations that responded.\*













<sup>\*</sup>Results reported in this presentation are not attributed to protect confidentiality.

# Background on the Data for this Presentation



Organizational and project leaders decided which measures were most useful to them when tracking the results of CMMI-based improvements.

A common thread was their interest in measuring the effect CMMI had on schedule, effort and cost, and quality.

The summarized results demonstrate the wide scope of business values and goals of the participating organizations.

The source studies in this presentation used current data as follows:

- 2010: Organizations 1, 2A, 3, & 6
- 2009: Organizations 5 & 7
- 2008: Organization 2B

# **Quantitative Measures: Schedule Performance Results Summary**



| <b>Measure Used By The Organization</b>              | Performance Result  |
|--|---|
| On-time deliverables (Organization 2a)               | On-time deliverable improvement of 4.9% out of a possible 5% improvement – closed the gap to within 0.1% of perfection (organization went from 95% to 99.9% of deliveries on time)        |
| Earlier Defect Detection and Repair (Organization 1) | 6.35 times less defect discovery and repair hours after start of system testing; potential savings of 5 – 6.5 months in schedule delay after system tests begin for average sized project |
| Schedule performance index (Organization 7)          | Increased from .78 to .93 over three years (a 19.2% improvement in estimation and execution of schedule)  |

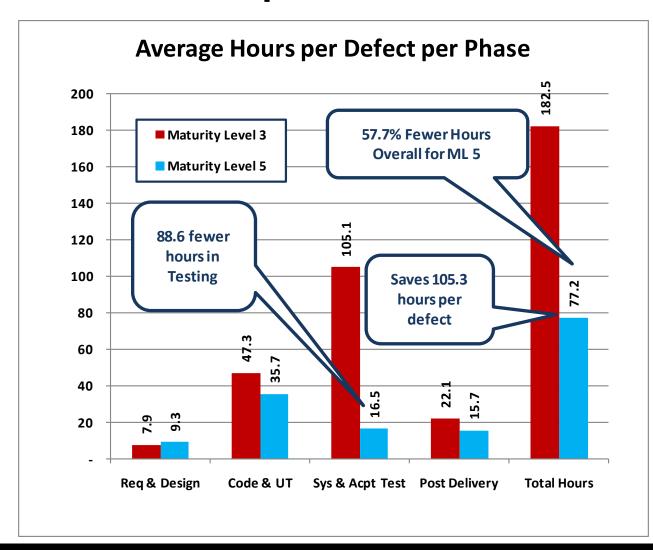
# **Quantitative Measures: Effort (Rework) and Cost Performance Results Summary**



| Measure Used By The Organization  | Performance Result   |
|---|--|
| Total hours for defect repair (Organization 1)  | 58% fewer hours needed to repair defects for ML5 versus ML3; Result: a potential cost savings of \$1.9 to \$2.3 M per average-sized project (defined as 233 KESLOC [Kilo Equivalent Source Lines of Code]) |
| Hours per KLOC to find and fix defects for CMMI ML5 relative to the SW-CMMI ML3 baseline (Organization 6) | Defect find and fix cost down 22%  |
| Effort hours needed to repair high severity defects in integration and test phases (Organization 4)       | 24% reduction in effort hours per defect   |
| Cost performance index (Organization 4)   | Increased from .88 to .96 over two years   |
| Overhead rates for CMMI ML5 relative to the SW-CMMI ML3 baseline (Organization 6)                         | Reduced by 7.3%  |
| Software development cost for CMMI ML5 relative to the SW-CMMI ML3 baseline (Organization 6)              | Reduced by 28%   |

# Selected Results: High Maturity Reduces Costs for Repair (Organization 1)





# High Maturity Projects Discover defects earlier

Early detection and repair lowers Costs

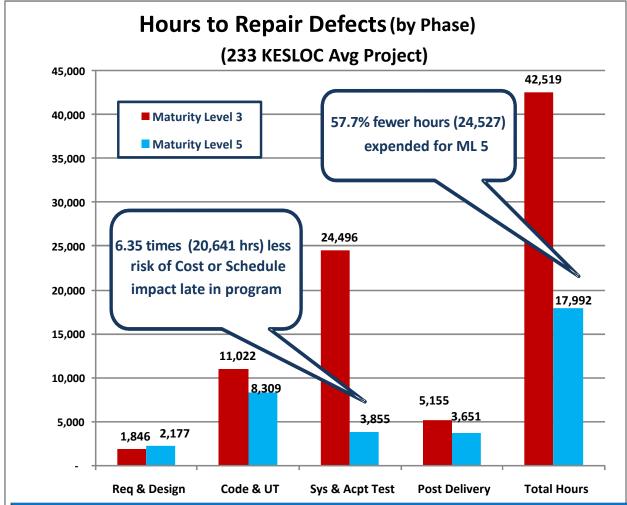
**57.7%** fewer hours for ML5 projects expended to repair defects versus ML3

**105.3** fewer hours per defect

- 88.6 fewer hours during Testing alone
- When largest risk to schedule occurs

# Selected Results: Effort to Repair Defects by Phase (Organization 1)





Potential Cost Savings From \$ 1.9 M to \$2.3 M per average sized program



# **Quantitative Measures: Quality Performance Results Summary**



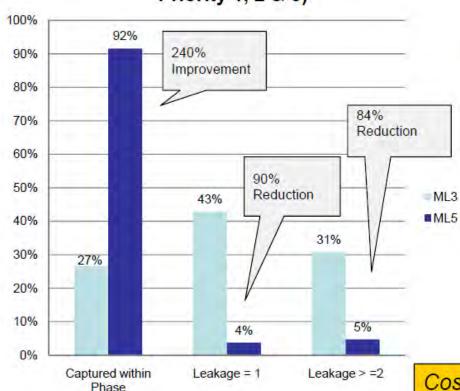
| Measure Used By The Organization  | Performance Result   |
|---|--|
| Defect density by severity, ML5 compared to ML3 (Organization 1)  | 62.5% fewer high-severity defects with ML5 projects                      |
| Defect density in circuit board design (Organization 2a)  | 65% improvement  |
| Defect containment by phase (Organization 3)  | The fix of defects within the phase they were injected increased by 240% |
| Defect containment, ML5 compared to ML3, by phase per KLOC (thousands of lines of code) (Organization 2b) | Defect containment improved 13%  |
| User acceptance test defects per KLOC (Organization 7)  | Less than 0.15 defects per KLOC  |
| % of defects removed prior to system test (Organization 7)  | >85%   |

## **Selected Results: Quality Performance**

(Organization 3)



## Defects Phase Containment / Leakage (High Severity Defects -Priority 1, 2 & 3)



### Within ML5 projects:

- Defect containment (within phase) is increased by 240%
- Leakage is reduced by 90% for defects discovered "1 phase later"

84% reduction in defects leaked "2 or 2+ Phases"

### Optimizing verification activities:

- Peer reviews
- Unit testing
- Integration testing

## Cost avoidance realized:

- Less rework late in the life cycle when it is most expensive to repair
  - Resulting in reduced schedule risk

# **Quantitative Measures: Productivity Results Summary**



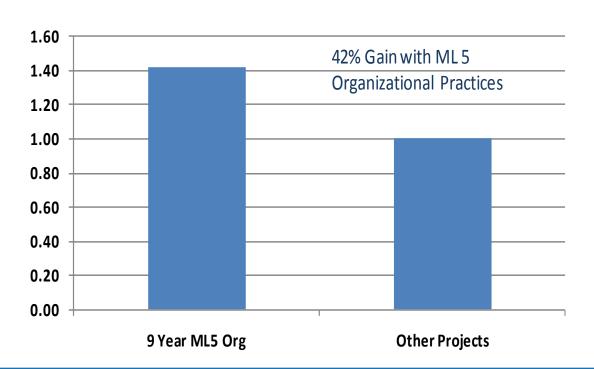
| Measure Used By The Organization  | Performance Result                                      |
|---|---|
| Productivity Gain with ML5 (Organization 1)   | 42% gain with ML5 organizational practices over 9 years |
| Organizational productivity vs. Galorath SEER SEM Estimation Model (Organization 1) | Production hours reduction: 33.0% at ML3; 37.4% at ML5  |
| Productivity for CMMI ML5 relative to the SW-CMM ML3 baseline (Organization 6)      | Productivity up 25.2%                                   |

# **Selected Results: Software Productivity**



(Organization 1)

## **Productivity Gain with Long Term ML 5**



Average project size was 233 KESLOC

Largest = 1,360 KESLOC Smallest = 29 KESLOC

Average customer project savings due to increased productivity
 Equivalent of 406 work months per project (33.8 work years)

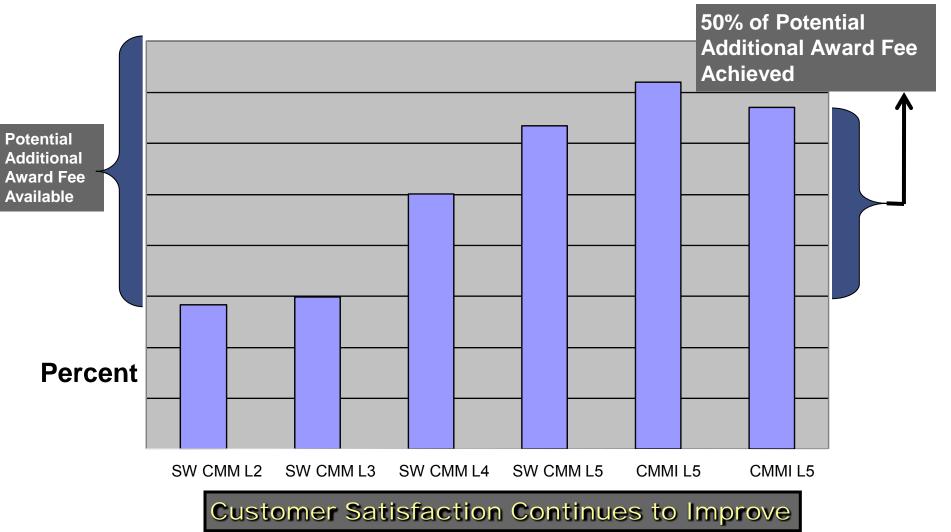
# **Quantitative Measures: Customer Satisfaction Results Summary**



| Measure Used By The Organization  | Performance Result                             |
|---|--|
| Award fee (used as an indicator of customer satisfaction) for CMMI ML5 relative to the SW-CMM ML2 baseline (Organization 6) | 50% of potential additional award fee achieved |
| Cost savings to customer in a cost-plus contract (Organization 1)   | Rose from 5.7 M to 7.1 M (25%)                 |

## Selected Results: Award Fee (Organization 6)





## **Quantitative Result: Return on Investment**

(Organization 2a)



Organization 2a reported their quantified ROI from CMMI Maturity Level 5 activity to be 24:1.

Using the data in *Performance Results of CMMI® -Based* Process Improvement (CMU/SEI-2006-TR-004) they were able to compare their ROI performance to others in industry:

Median ROI

Lowest ROI

**Highest ROI** 

4:1 1.7:1 Organization 2a 24:1 27.7:1

These results are a consequence of meaningful process improvement aligned with the business and engineering objectives.

# **Putting This Presentation In Perspective**



The reporting organizations have a long history of commitment to CMMI

Many have a history of multiple reappraisals at high maturity levels over many years

All these organizations clearly embody an approach that incorporates adherence to process as part of their operating principles

None of these organizations would have been able to collect and analyze the years of data needed to document these results if they were "bookshelf process" organizations

# **Putting This Presentation In Perspective - 2**



Each organization measured their own internal processes

- CMMI measures how well an organization follows their process
- Maturity Levels are used to provide a relative basis of comparison
  - CMMI is a good tool to define states of maturity
  - Measurements demonstrate the value received

The benefits described came from execution of each organization's processes

- Each organization identified areas different areas of focus
- Gains were achieved when process focus occurred

The combination that yielded value:

CMMI provided the **benchmark and the framework** 

Adherence to their processes produced the value.

# CMMI Provides Many Qualitative Benefits as Well\*



Organizations also gathered various qualitative measures to compliment their quantitative measurements. They found qualitative benefits such as:



- Reduced overtime and less intense pressure
- Clear roles and responsibilities for business execution
- Common language (i.e., defined processes, measures) across business units
- Decrease in replanning
- Products with lower levels of defects and lower risk; one organization offers a lifetime warranty on products

- Improved program insight, control, and tracking
- Reduced training: process documentation enables knowledge transfer to new generation of workers
- Process transformation (via consistency, integration, coordination)
- Personnel retention and job satisfaction

\*based on published benefits from a wide variety of organizations

## The Bottom Line



# Why improve processes? - Because processes are the foundation for all other business improvements, and critical for

- lasting improvements
- successful technology insertion

If a performance management system is not in use, leadership is unaware of what is and is not working.

CMMI is a proven approach to performance management – with more than a decade of results showing it *does* work.

Organizations have provided data that shows CMMI

- enables the delivery of lower-defect products, with predictable cost, schedule, and quality
- improves business performance
- serves as competitive discriminator

# **CMMI** Works for Organizations of All Sizes



1001 to 2000 3.7% 6.8%

2000+ 2.5%

1 to 100 58.2%

301 to 500 7.4% 25 or fewer 13.6%

201 to 300 9.0%

> 26 to 50 15.6%

201 to 2000+ 23.8%

101 to 200 19.8%

> 51 to 75 12.8%

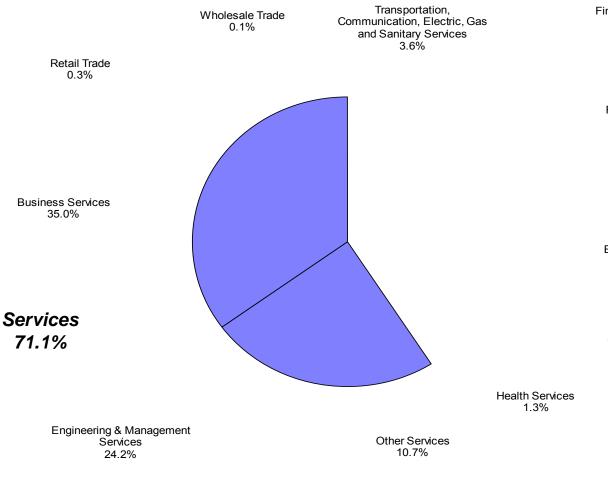
76 to 100 8.9%

Source for these statistical analyses: <a href="http://www.sei.cmu.edu/cmmi/casestudies/profiles/cmmi.cfm">http://www.sei.cmu.edu/cmmi/casestudies/profiles/cmmi.cfm</a>



# **CMMI Adoption Is Multi-Sector**





Finance, Insurance and Real Estate 5.5%

> Public Administration (Including Defense) 3.2%

Fabricated Metal Products 0.2%

Primary Metal Industries 0.3%

Industrial Machinery And Equipment 0.7%

Electronic & Other Electric Equipment 10.4%

Instruments And Related Products 1.0%

Transportation Equipment 2.4%

Other Manufacturing Industries 1.2%

Manufacturing 16.3%

Source for these statistical analyses: <a href="http://www.sei.cmu.edu/cmmi/casestudies/profiles/cmmi.cfm">http://www.sei.cmu.edu/cmmi/casestudies/profiles/cmmi.cfm</a>

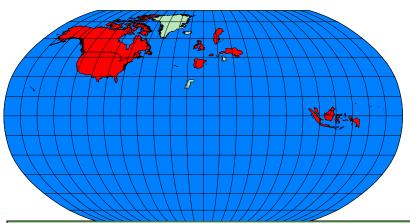


# **CMMI Adoption Knows No Borders**



## There are 33 countries with more than ten appraisals as of March 2010:

| USA         | 1582 |
|-------------|------|
| China       | 1229 |
| India       | 524  |
| Japan       | 306  |
| Spain       | 180  |
| France      | 168  |
| Korea (ROK) | 165  |
| Brazil      | 144  |
| Taiwan      | 134  |
| U.K.        | 113  |
| Mexico      | 86   |
| Argentina   | 77   |
| Germany     | 76   |
| Malaysia    | 71   |
| Canada      | 59   |
| Egypt       | 43   |
| Italy       | 43   |
| Thailand    | 38   |
| Chile       | 37   |
| Australia   | 36   |



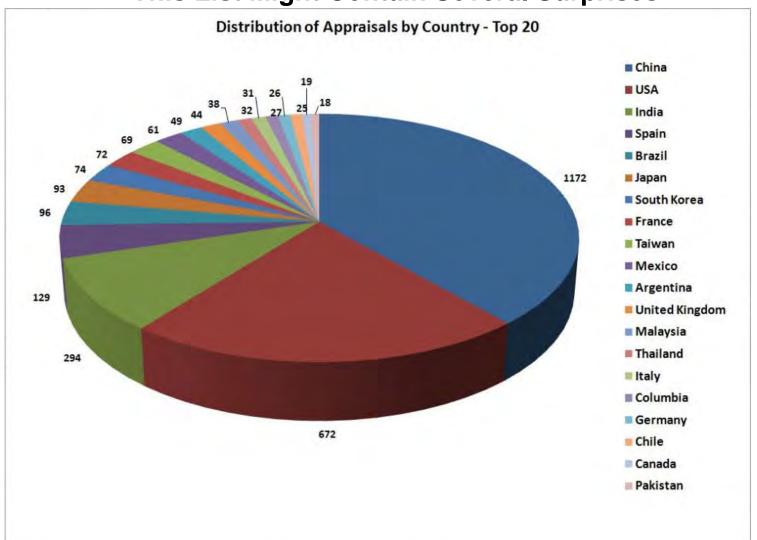
An estimated 1.8 million people work in organizations that have had at least one SCAMPI A appraisal since April 2002.

Also: Colombia, Pakistan, Philippines, Singapore, Israel, Hong Kong, Vietnam, Turkey, Netherlands, Portugal, Sri Lanka, Ireland and Russia

## **Countries With Current Appraisals**

## - This List Might Contain Several Surprises





Data through Nov 12, 2010



# **Results Depend on Implementation**



Simply deciding to "do CMMI" is not enough to achieve benefits.

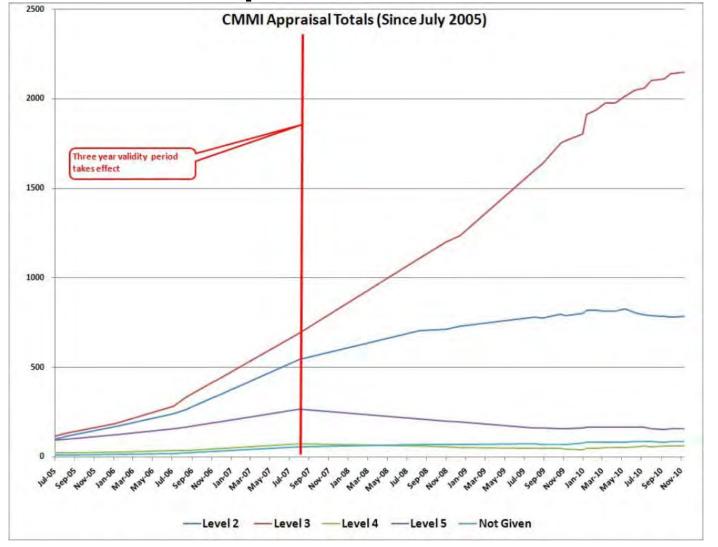
Defining good processes, using them, measuring the results, and making improvements based on what you learn are all key to reaping the benefits described in this presentation.

The CMMI models are a foundational part of a comprehensive approach to process improvement that helps organizations understand

- why they should improve
- what frameworks and tools would best fit their needs
- how to implement them

# What Does Adoption Data Tell Us





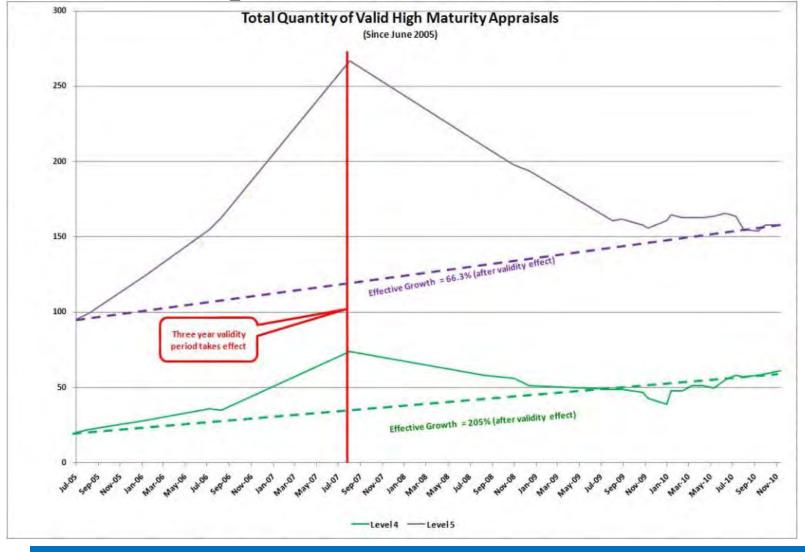
Data through Nov 12, 2010

Growth in High Maturity appears to be stagnated



# **Unmasking the HiMat Trends**



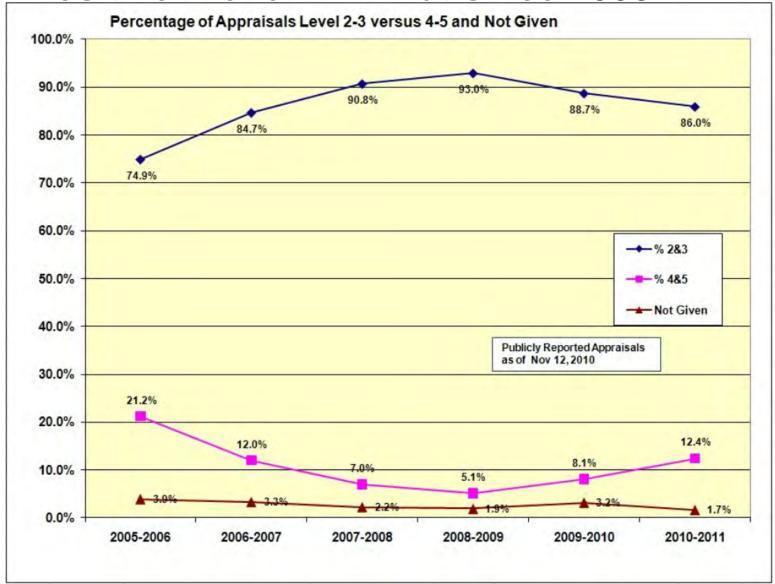


Data through Nov 12, 2010

Real Growth in ML 4 & ML 5 over 5 years - recent ML 4 tracks the ML 3 surge



#### Positive Trend in Hi Mat since 2008





Data through Nov 12, 2010



#### Misreading the Tea Leaves on HiMAT?



The huge surge in ML 2 & 3 appraisals starting in 2007 may have created a masking function as the validity limit on appraisal life was taking effect

Reductions evident in ML 4 & 5 have not been evident for ML 2 & 3

Maturity growth normally takes several years to occur

 SW CMM maturity took over 6 years to take hold so the condition is not new

We may have seen the HiMAT % reduced simply because appraisal totals were growing at an accelerated rate

We need to monitor these trends.

HiMAT growth may have been more stable than we thought

## Recent Research on CMMI: Just the Tip of the Iceberg!





#### **CMMI** Research - References



#### Bibliographic information cited in this presentation:

| Gibson, Diane; Goldenson, Dennis R.; and Kost, Keith.<br>Performance Results of CMMI-Based Process Improvement (CMU/SEI-2006-TR-004). Pittsburgh, PA: Software<br>Engineering Institute, Carnegie Mellon University, August 2006.  | Journal Issue: "Performance Results from Process Improvement." SoftwareTech News. Vol. 10, Number 1. March 2007.   |
|--|--|
| Goldenson, Dennis R. and Gibson, Diane L. <i>Demonstrating the Impact and Benefits of CMMI®: An Update and Preliminary Results.</i> (CMU/SEI-2003-SR-009). Pittsburgh, PA: Software Engineering Institute, Carnegie Mellon University, October 2003.   | Journal Issue: "CMMI: Getting a Handle on Process." CrossTalk. Vol. 23, Number 1. Jan/Feb 2010.  |
| Herbsleb, James D.; Carleton, Anita; Rozum, James A.; Siegel, Jane; and Zubrow, David. <i>Benefits of CMM-Based Software Process Improvement: Initial Results*</i> (CMU/SEI-94-TR-013). Pittsburgh, PA: Software Engineering Institute, Carnegie Mellon University, August 1994. (*Also see SEI Special Report: <i>Benefits of CMM-Based Software Process Improvement: Executive Summary of Initial Results</i> , CMU/SEI-94-SR-013) | Stoddard II, Robert W. and Goldenson, Dennis R.<br>Approaches to Process Performance Modeling: A Summary from the SEI Series of Workshops on CMMI High Maturity<br>Measurement and Analysis (CMU/SEI-2009-TR-021).<br>Pittsburgh, PA: Software Engineering Institute, Carnegie<br>Mellon University, January 2010. |
| Jones, Capers. Assessment and Control of Software Risks. Upper Saddle River, NJ: Prentice-Hall, 1994 (ISBN 0-13-741406-4).   | Website about CMMI at the Software Engineering Institute: <a href="http://www.sei.cmu.edu/cmmi/index.cfm">http://www.sei.cmu.edu/cmmi/index.cfm</a> >  |

#### **Looking Ahead**

#### The road ahead for CMMI implementation



- A continued focus on high maturity
  - More and more organizations are striving for and achieving high maturity and are collecting data demonstrating the benefits. Once at ML 4 or 5, organizations must maintain their focus on good implementation practices for continuous improvement.
- Implementation of CMMI for Services (CMMI-SVC)
   CMMI-SVC extends the benefits of CMMI to a new audience. Service providers can use the model concept that has proven useful in the development community to specifically address their interests and concerns.
- Implementation of CMMI for Acquisition (CMMI-ACQ)
   CMMI-ACQ helps organizations improve relationships with their suppliers and improve acquisition processes. The model can enable increased control of projects, better management of global sourcing of products and services, and more successful acquisition solutions.
- Integration with other improvement paradigms (e.g., TSP, ISO, Lean Six Sigma)
   Organizations are finding that integrated improvement initiatives can produce outstanding results. Choosing CMMI doesn't mean discontinuing improvement efforts already in place or avoiding new ones that show promise.

#### **Summary**



Many stakeholders are involved in the development and maintenance of CMMI models, with participants from commercial industry, government, and the DoD. Broad adoption has occurred worldwide. Adopters range from small and midsize organizations (these are the majority) to large and very large organizations.

Organizations that provide products and services to the DoD use CMMI to improve programs, systems, product and service management, systems and software engineering, work processes, and training solutions.

Quantitative and qualitative results have been documented by defense contractors and others, as shown in this report. There is a great deal of additional data showing the benefits of CMMI from a broad range of industries, including banking and finance, manufacturing, medical, and others.

CMMI enables performance improvement focused on business objectives, but the level of success depends on the implementation.

#### Who Benefits from CMMI Today?









# Multi-Model Organizational Process Quality Assurance Program

#### Prepared for:



November 17, 2010



#### A Professional Services Technology Firm

- Founded in 1992, building technology solutions for bank and & brokerage clients
- Expanded to complex transaction, system integration, and compliance problems
- •Solutions used by over 200,000 professional users in 140 countries
- Provide analysis, software development, data, and data center services
- •75 Fulltime Employees, ~\$18 million in Revenue

## Agenda

- Overview
- Kingland System's Path to PPQA
- Mapping Internal Processes to External Models
- Reporting Compliance
- Preparing for external audits/appraisals
- Conclusion



#### Overview

Organizations typically leverage multiple models to guide internal processes.



Devel







**Internal Processes** 











The trick is to effectively map them for a complete enterprise-wide view.



## Our Original Approach to PPQA: Individual Process Audits

- Started with separate audits for each process
- Each process was audited one time per project
- Averaged 5 audits per project, at ~4 hours each
- Paper audit checklists were used

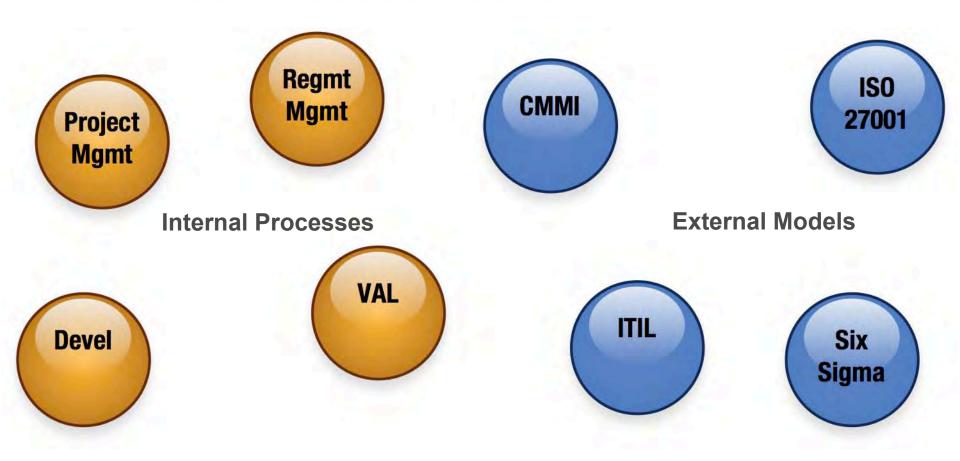


# Our Original Approach to PPQA: Individual Process Audits

- Audits focused on the evidence existing, rather than the quality of the evidence/effectiveness of the process
- No direct traceability back to the CMMI model
- This model was unsustainable:
  - Time intensive, manual
  - More audits as processes were added
  - Didn't ensure compliance across a project's lifecycle

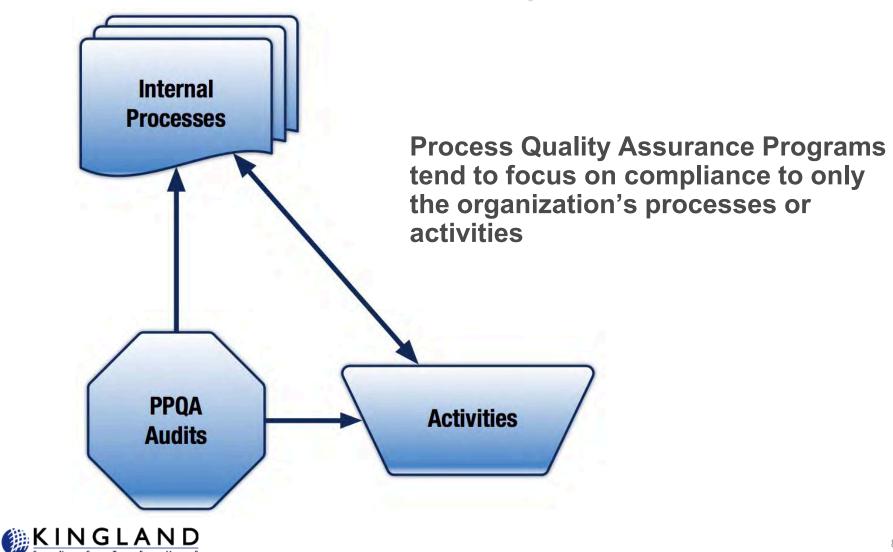


# Our Original Approach to PPQA: Individual Process Audits

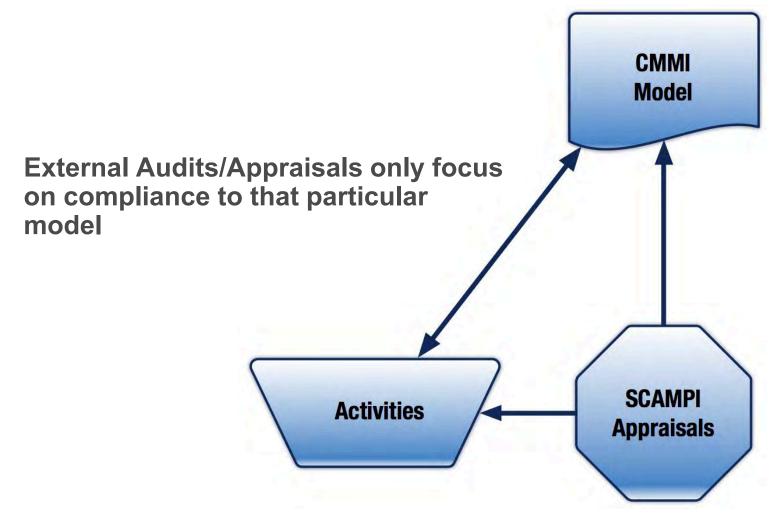


Internal Processes and External Models were silos, with no traceability or visibility across

#### Overview – Internal Perspective

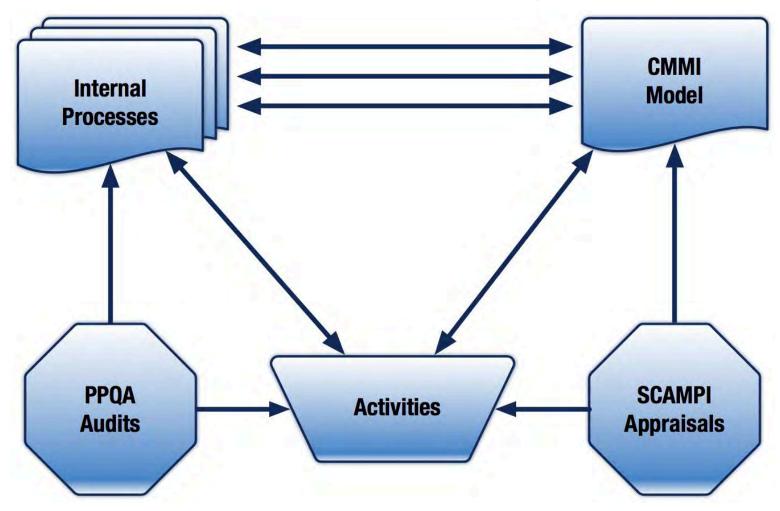


### Overview – External Perspective





#### Overview - Combined Perspective





The goal is to have a comprehensive view across internal process and external model compliance

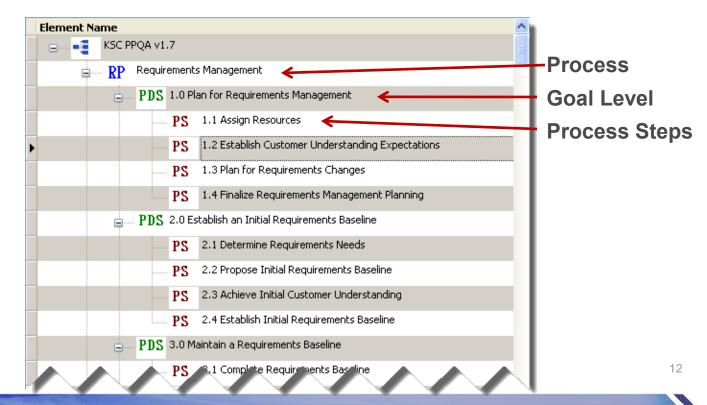
## Second Approach to PPQA: Milestone Audits

- Performed audits across processes at milestones:
  - Planning Complete
  - Elaboration Complete
  - Development Complete
  - Transition Complete
- Examined aspects of the processes that were appropriate for each milestone
- Ensured compliance across a project's lifecycle
- Began to leverage tooling to eliminate manual effort



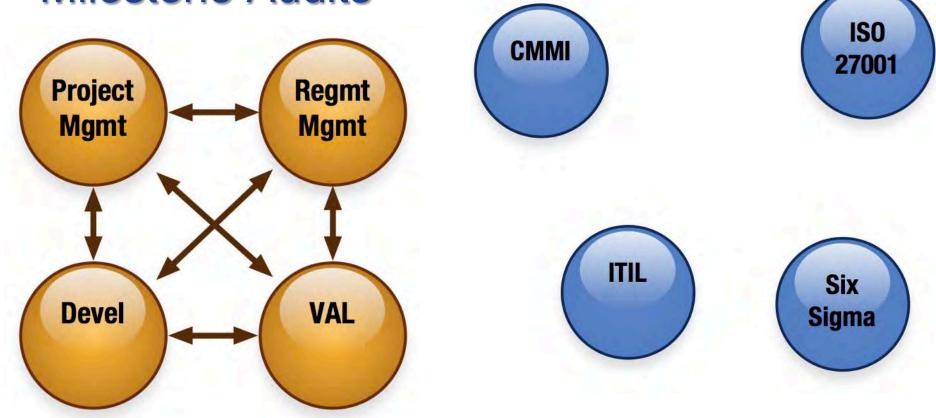
## Second Approach to PPQA: Milestone Audits

- Began using tooling to support Audits
- Audited by process step, focusing more on quality of evidence and effectiveness of the process





Second Approach to PPQA: Milestone Audits



Started to see internal process traceability, but still no visibility across to the external models



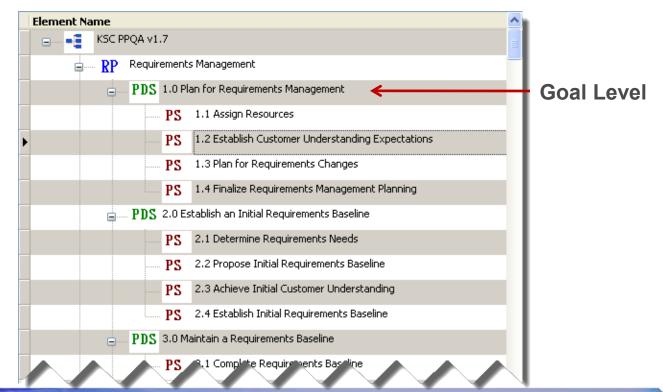
## Current Approach to PPQA

- Still perform audits across processes at milestones
- Still examine process sequences that are appropriate for each milestone
- Still ensure compliance across a project's lifecycle
- Increased use of tooling to:
  - Support Audits
  - Report compliance against internal processes
  - Map and identify gaps across external models
- Different Approach to audit focus



## Current Approach to PPQA

- Audit projects at the goal level, ensuring that projects:
  - Meet the goal of each process sequence
  - Their plans are consistent with the process
  - Their activities are consistent with their plans





## **Guiding Principles**

- All processes will be audited
- Ensure everyone is performing consistently
- Compliance evaluated against goals of each process sequence
- Map internal processes to external models, driving the model to the background
- Leverage audits to provide coaching as well as provide a vehicle for process improvement
- Provide feedback to the project teams and follow-up on noncompliance items



#### **Lessons Learned**

- Evaluation at the goal level allows for better mapping to external models
- Need objective rules in place for evaluation
  - Goal Achieved
  - Team's Plan consistent with the Process
  - Team's Activities consistent with their plan
- Auditor Guidance within checklists is a <u>must</u> to maintain consistency of audits
- Having auditors review evidence in advance, followed by interviews with team members is much more efficient (SCAMPIlike events)

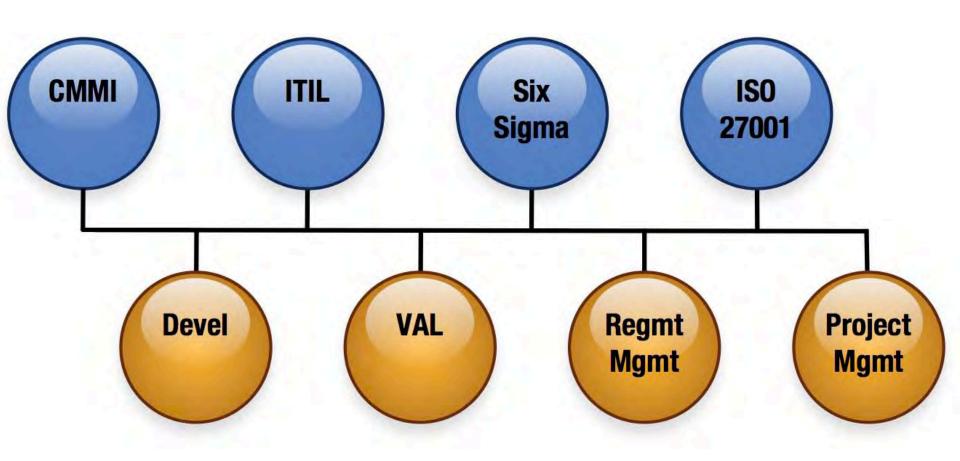


#### **Lessons Learned**

- Tooling allowed us to have better record retention, trending, and reference for internal audits
- Reduced average time spent on audits per project by 24%
- Increased process compliance by 46%



### Current Approach to PPQA





The current approach allows us to have a comprehensive view across internal processes and external models

### **Tooling**

#### Appraisal Wizard Suite by Integrated System Diagnostics, Inc.

#### Appraisal Wizard

- Used for PPQA Audits and SCAMPI Appraisals
- Database of checklist questions, evidence examined, and ratings tied to the process(es) being evaluated

#### Model Wizard

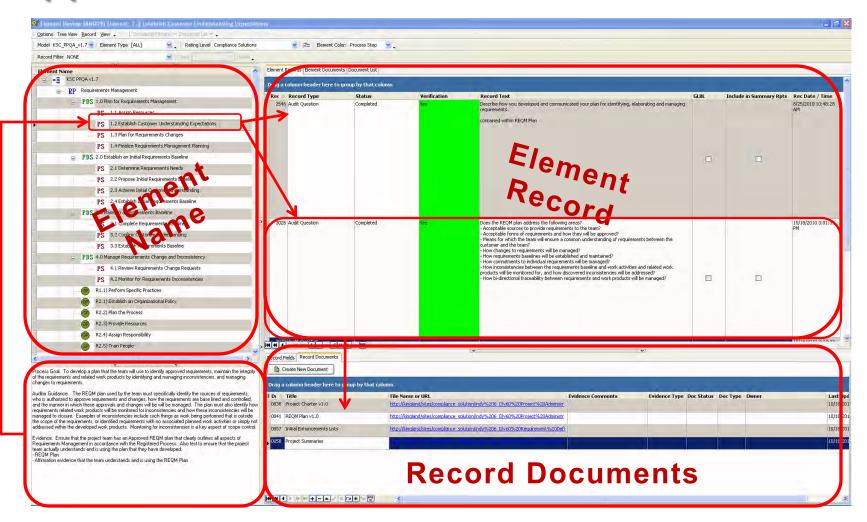
- Used to design models for use in Audits and Appraisals
- Ability to import organizational processes
- Contains models such as CMMI, ISO, etc.

#### Model Mapper

- Used to map internal processes to external models
- Contains maps across external models such as CMMI to ISO, etc.

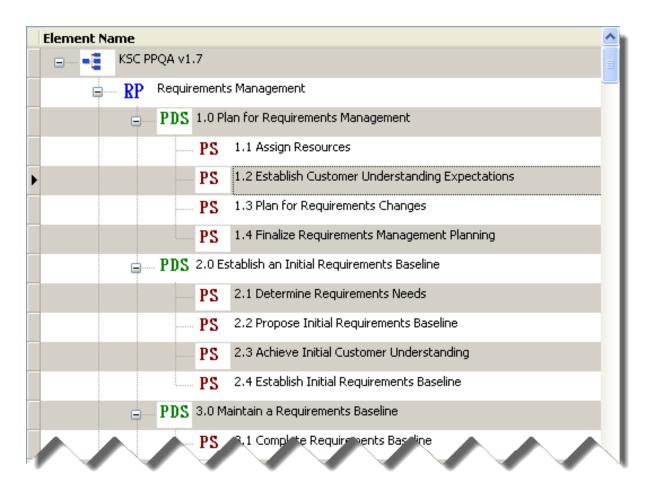


## **Appraisal Wizard**





#### Appraisal Wizard – Element Name





### Appraisal Wizard – Element Records

| ≣ Rec ∇ Record Type | Status    | Verification | Record Text   |
|---------------------|-----------|--------------|---|
| 3026 Audit Question | Completed | Yes          | Does the REQM plan address the following areas?  - Acceptable sources to provide requirements to the team?  - Acceptable forms of requirements and how they will be approved?  - Means for which the team will ensure a common understanding of requirements between the customer and the team?  - How changes to requirements will be managed?  - How requirements baselines will be established and maintained?  - How commitments to individual requirements will be managed?  - How inconsistencies between the requirements baseline and work activities and related work products will be monitored for, and how discovered inconsistencies will be addressed?  - How bi-directional traceability between requirements and work products will be managed? |

Includes questions and checklist information for auditors



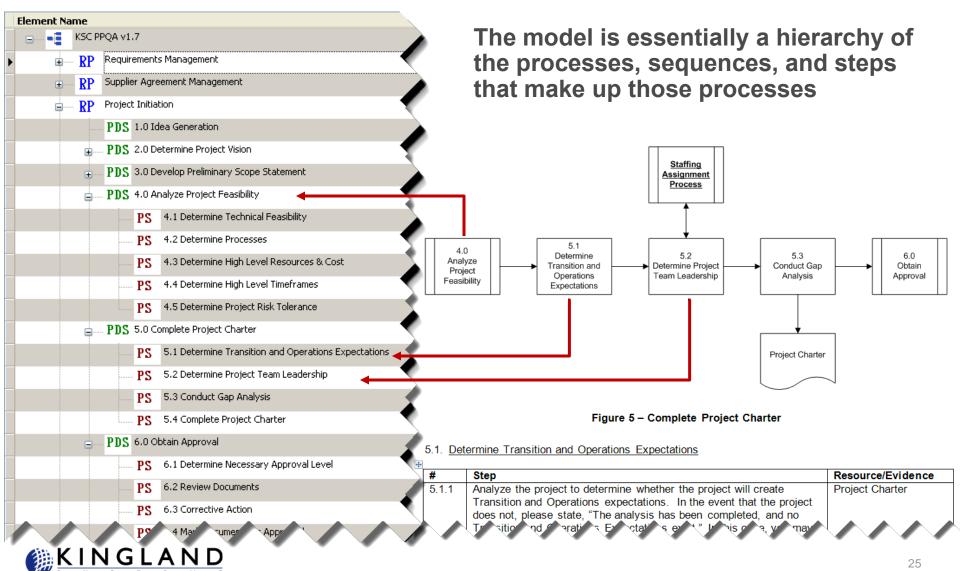
### Appraisal Wizard – Record Documents

| Dr 🛆 | Title                                 | File Name or URL  | <b>Evidence Comments</b> |
|------|---------------------------------------|---|--------------------------|
| 0041 | REQM Plan v1.0                        | http://kingland/sites/compliance_solution/indy%206_0/v60%20Project%20Administr    |                          |
| 0052 | Requirements Traceability Matrix v1.2 | http://kingland.kingland.cc/sites/compliance_solution/Document%20Library6/1/Indep |                          |

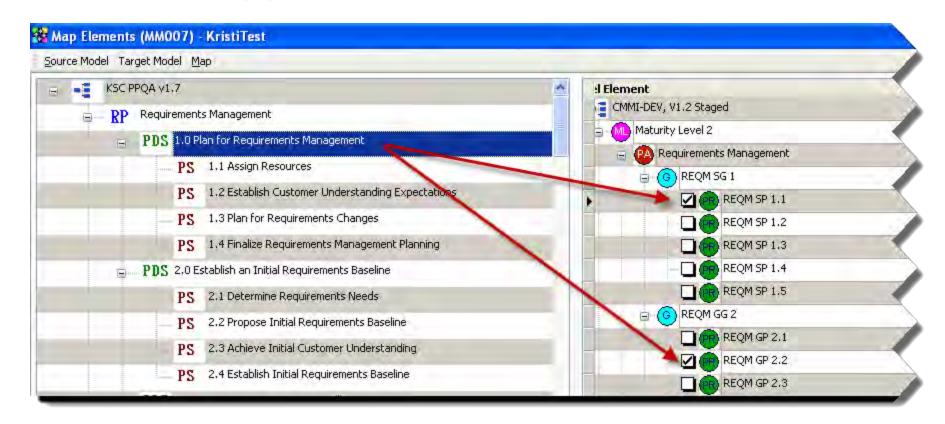
Includes evidence examined for each question



#### Model Wizard



### Model Mapper



Enables mapping from one process or model to another



## Model Mapper

| Element   | Mapped Elements | Link Comment   | Certainty |
|---|-----------------|--|-----------|
| 2.0 Establish an<br>Initial Requirements<br>Baseline: | - REQM SP 1.1   | Link Comments: After contingent commitment from the<br>team, the initial requirements are provided to the<br>customer for validation and approval. Once recieved,<br>these are baselined in the RTM and become the basis for | 100       |
| KSC Process   | CMMI Model      | subsequent planning  |           |

Rationale behind the mappings and coverage certainty can also be captured and used for additional visibility and reporting



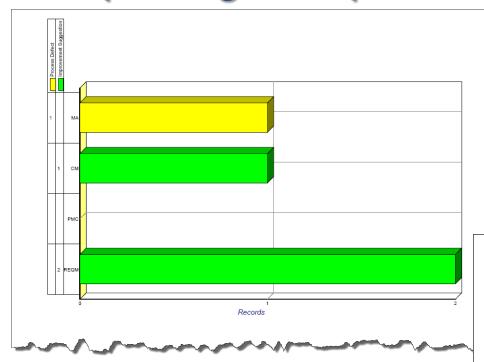
## Reporting Compliance

| RE QM | RE QM 1.0  | RE QM 2.0        | RE QM 3.0 | RE QM 4.0 |         |        |        |   |
|-------|--|------------------|-----------|-----------|---------|--------|--------|---|
| PMC   | PMC1.0   | PMC 2.0          | PMC3.0    | PMC4.0    | PMC 5.0 |        |        |   |
| M     | CM 1.0   | CM 2.0           | CM 3.0    | CM 4.0    |         |        |        |   |
| MA    | MA 1.0   | MA 2.0           | MA 3.0    | MA 4.0    | MA 5.0  | MA 6.0 | MA 7.0 | 1 |
|       | NA [2 / 3.9%]<br>Compliant [12 / 23.<br>Major Noncomplia |                  |           |           |         |        |        |   |
|       |  |                  |           |           |         |        |        |   |
|       | Minor Noncomplai   | int [4 / 7.8%]   |           |           |         |        |        |   |
|       | No Rating Assigne  | ed] [31 / 60.8%] |           |           |         |        |        |   |
|       |  |                  |           |           |         |        |        |   |

Generate reports on internal process compliance



### Reporting Compliance



#### Component

#### 6.0 Analyze and Interpret Data

Analysis and interpretation of the data.

- 6.1 Consider the source
- 6.2 Consider the purpose
- 6.3 Consider the context
- 6.4 Develop Conclusions

#### Rec ID Record Text

3000 Are the activities that are associated with this process sequence consistent with the teams Project Plan?

There is no evidence of an analysis being performed on the metrics that are currently being reported. There is also no evidence that things "aren't as expected", but would be good to see the team using the metrics more proactively and performing an analysis along with the calculations (at progress status meetings, milestones, etc.) to determine if everything is as expected of if something may need to change on the project.



**Generate reports on findings** 

## Gap Analysis

#### **Map Report - Unmapped Model Elements**

KSC\_PPQAv1.7 to CMMI Dev v1.2

Source Model: KSC PPQA v1.7

Target Model: CMMI-DEV, V1.2 Staged

KSC PPQA v1.7

Element Name

KSC PPQA v1.7

Element Name

KSC PPQA v1.7

2.2 Establish Evaluation Criteria

Requirements Management

2.3 Determine List of Potential Suppliers

2.4 Gather Information

#### **Model Map Report**

KSC\_PPQAv1.7 to CMMI Dev v1.2

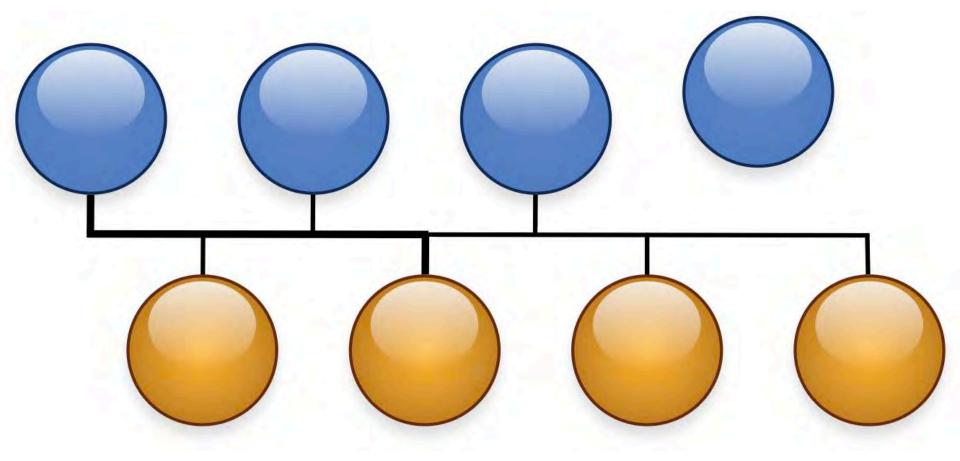
Source Model: KSC PPQA v1.7

Target Model: CMMI-DEV, V1.2 Staged

| Element                           | Mapped Elements | Link Comment   | Certainty |
|-----------------------------------|-----------------|--|-----------|
| 1.0 Analyze<br>Stakeholder Needs: | - PP SP 2.6     | Link Comments:Identifies stakholders and determines level of necessary invovlement | 50        |
|                                   | - PP GP 2.7     |  | 50        |



## Gap Analysis

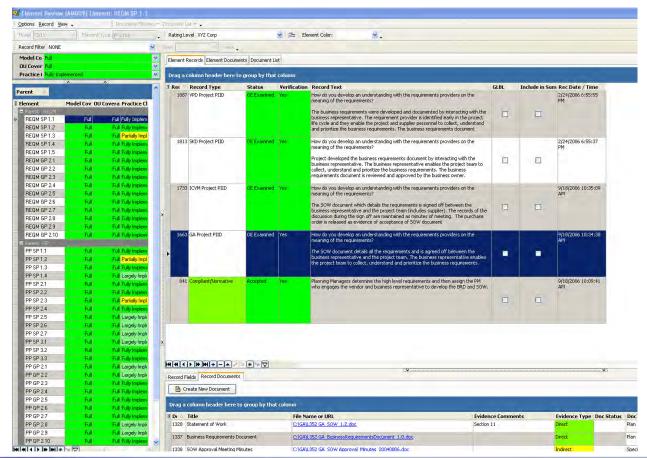




Create reports to understand alignment of internal processes relative to external models, to see where there are gaps and strong alignment

## Preparing for SCAMPI Appraisals

- From our internal audits, the tool already includes evidence/information in preparation for SCAMPI Appraisals
- Reduced time spent in preparation for a SCAMPI by 21%





### Conclusion

How do you ensure that your program has a complete view across internal processes and external models?

- Ensure internal processes are addressing external practices
- Map internal processes to industry models
- Provide a means to report on and modify the mapping
- Provide visibility of compliance between internal processes and external models





## **Questions / Discussion**



## Thank You

For questions related to this presentation, please contact:

Kristi Kingland Glowaski 641.355.1017 Kristi.Kingland@Kingland.com







# Achieving Successful CMMI-DEV Practice Implementation Across Diverse Distributed Environments In Small Organizations







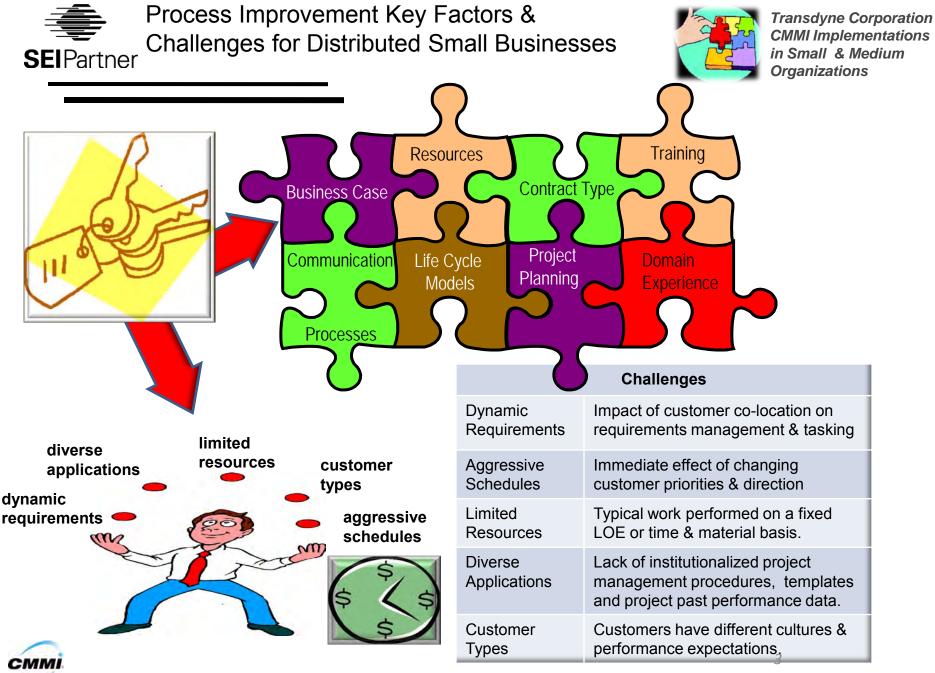
#### Agenda



#### Agenda

- Process Improvement Key Factors & Challenges for Distributed Small Businesses
- Scenario for Implementing Process Improvement Practices Across
   Distributed Small Businesses
- Bridging Distributed Environments Using CMMI-DEV for Distributed Small Businesses
- CMMI-DEV Practice Implementation for Distributed Small Businesses
- Steps for CMMI-DEV Practice Implementation for Distributed Small Businesses
- Strategy Map for Using Audits and Appraisals
- Lessons Learned Success Factors







#### Scenario for Implementing Process Improvement Practices Across Distributed Small Businesses



Distributed small businesses often function in <u>focused</u> markets as:

- Suppliers of specialized on-site technical services, key personnel or products
- Domain specialists
- Staff augmentation

These focused markets may not provide needed <u>revenue</u> or market share <u>growth</u> to readily prosper in today's economy.



**Costs of improving** management practices are considered key investments in these vulnerable cash flow environments.

Both near and long term **cash flow analysis** typically includes factors such as:

- Customer base stability & revenue cycles
- Projected revenue growth
- Costs of acquiring appropriate resources to improve management practices, such as training, process engineers and collaborative software and hardware.





#### Scenario for Implementing Process Improvement Practices for Distributed Small Businesses (continued)



Understanding and improving project management practices is a key factor in <u>revenue growth</u>.

Planning improvement of project management typically includes assessment of critical factors such as:

- Required resources (available staff, feasible schedule, platforms, facilities, collaborative tools)
- Past performance data (costs, schedules, lessons learned)
- Training in the domain
- Risk identification and impact assessment
- Risk mitigation



**Process models** such as CMMI and ISO 9000 provide practical knowledge <u>bases</u> for improving management practices.

Obtaining **CMMI benchmarks** and ISO 9000 certifications are often stepping stones to expand government and commercial customers.

Selecting and **implementing any process models** is both **costly** and can be **risky** as there are no guarantees of success in distributed customer sites.





#### Scenario for Implementing Process Improvement Practices for Distributed Small Businesses (continued)



**Planning** *a* process improvement **strategy** typically includes identifying problematic projects with typical issues such as:

- Inaccurate planning data for costs and schedule
- Limited resources and ambitious schedules
- Lack of experience and staff training
- Excessive staff turnover rate
- Stability of current customer base
- Projection of market growth
- Over commitment of key staff



**Implementing** a process improvement **strategy**, distributed businesses should customize a path of small, adjustable steps.

An **example** of a path of small steps is a hybrid approach of improving project management practices in CMMI-DEV first.

The CMMI project management practices can provide a framework for future adoption of ISO 9000.





## Bridging Distributed Environments Using CMMI-DEV for Distributed Small



CMMI-DEV Provides Commonality

- Customer focused
- Requires continuous improvement
- Built on processes
- Focuses on resource management
- Based on measurement and analysis





Bridging
Techniques to
Achieve
Institutionalization

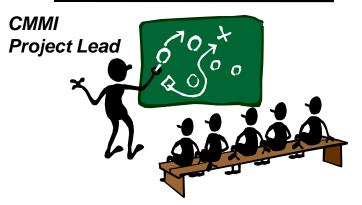
- Provide shared remote access
- Conduct site visits to understand different environments & cultures
- Take the initiative to talk daily
- Schedule weekly telecons with individuals at each site
- Integrate technical and engineering activities with life-cycle development tools that adapt to the dynamics of customer environments





## CMMI-DEV Practice Implementation for Distributed Small Businesses

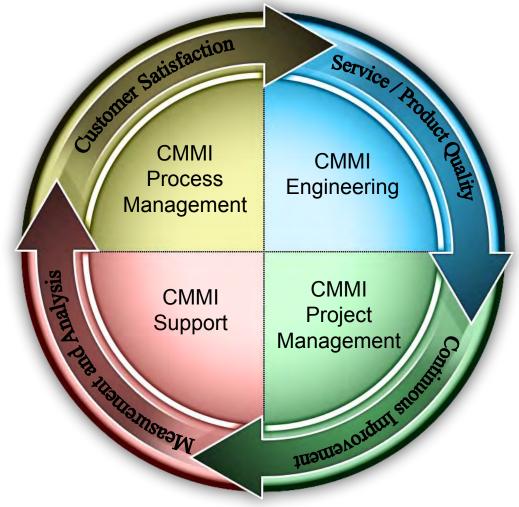




**Distributed Support Staff** 

**Frameworks** of the CMMI models provide:

- Increases in implementation efficiency due to redundancy in model functions, such as Project Management & Support Process Areas and generic practices.
- Minimal opportunities for conflicts with staff and resources with adequate model understanding



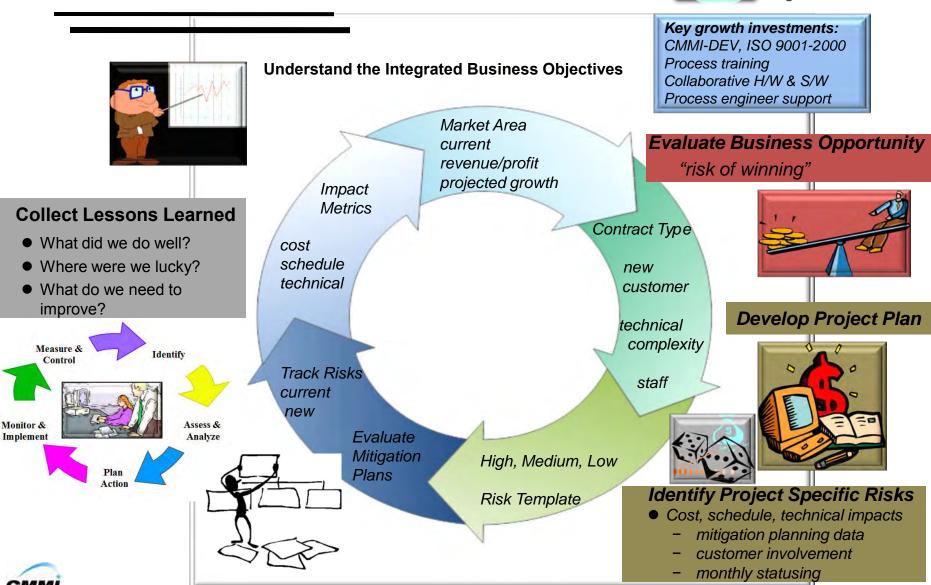




## Steps for CMMI-DEV Practice Implementation for Distributed Small Businesses



Transdyne Corporation CMMI Implementations in Small & Medium Organizations





## Strategy Map for Using Audits & Appraisals for Distributed Small Businesses





Strategy to achieve full goal satisfaction in all Process Areas for Maturity Level 3.



Quality PM or staff auditing of processes



Pre-Readiness Reviews Internal mini-team analysis of body of evidence





Readiness Reviews

- Formal analysis of body of evidence
- Assess readiness until proven

Appraisals

- SCAMPI C
- SCAMPI B
- SCAMPI A









#### Lessons Learned in Managing CMMI-DEV Practice Implementation for Distributed Small Businesses







- Understand that all process improvement opportunities are investments and have costs and risks as-well-as eventual returns on investment.
- Receive sustained management commitment in providing a dedicated project lead, suited support personnel, and resources.
- Avoid "surprises" by incorporating regular progress reviews into weekly senior management telecons.
- Include distributed site staff members in planning and reviewing practice implementation to understand the continuity and costs and identify the key risks, such as customer culture & expectations.
- ➤ Use the guidance of an SEI-trained lead appraiser from the beginning for strategy planning, model and appraisal training, and appraisals.
- Work from a thorough Process Improvement Plan which includes risks, costs, and schedule.





Lessons Learned in Managing CMMI-DEV Practice Implementation for Distributed Small Business (continued)



Transdyne Corporation CMMI Implementations in Small & Medium Organizations







- Implement practices with the use of consistent and approved tailored templates.
- Coordinate team process implementation and information sharing across geographically distributed sites using a collaborative file sharing capability e.g., SharePoint.
- Maintain progress and schedule by conducting weekly telecons with each support team member individually.
- Schedule and perform regular independent reviews of artifacts by the project lead and members of the support team.
- Conduct pre-readiness reviews before all appraisals.













You Have Just Seen:
Challenges and steps in
implementing CMMI-DEV
practices across a
distributed small business
from the "30,000 feet" level.



**Questions or Comments?** 









#### **Contact Information**



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A Service Disabled Veteran Owned Small
Business
SEI CMMI Maturity Level 3

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#### Transdyne Corporation

- Certified Instructor for the Introduction to the CMMI v1.2
- SEI Certified Lead Appraiser

Voice/FAX: (858) 271-1615 http://transdynecorp.com





# CMMI Bottoms-Up Assessment: a Grounded Analysis from the Perspective of Practicing Engineers in Defense Engineering

Dr. Bruce Beadell 17 November 2010

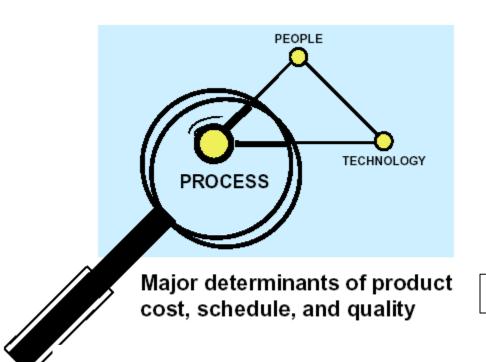
## **Presentation Topics**

- Quality Leverage Points Trilogy: Process, People, & Technology
- Social Theories Applied to CMMI: Marx, Taylor,
   & Weber

- CMMI Bottoms-Up Assessment: a Grounded Analysis from the Perspective of Practicing Engineers in Defense Engineering
- CMMI Case Study Conclusions & Recommendations

# Quality Leverage Points Trilogy: Process, People, Technology

Everyone realizes the importance of having a motivated, quality work force but...



...even our finest people can't perform at their best when the process is not understood or operating "at its best."

←Process, People, Technology

Source: SEI CMMI V1.2

## What About People?

### According to Watts Humphrey:

- ➤ "Talented people are the most important element in any software organization."
- ➤ "The better and more experienced they are, the better the chance of producing first-class results....First-class people are essential, but they need the support of an orderly process to do first-class work."
- What Can We Learn about People from Social Theories?

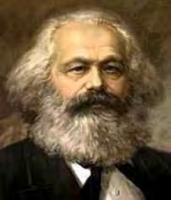
## Social Theories Applied to the CMMI © 🗵

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## **Conflict Theory – Karl Marx**

- Worker Alienation [Manuscripts of 1844]:
  - "The boss imposes the kind of work, the method and the rhythm, but never bothers if the worker ends up as: a mere appendage of flesh on a machine of iron."
  - "The deepest essence of man, his creative act, has been transformed into a possession."
  - "Alienation not only degrades man, but also depersonalises him."



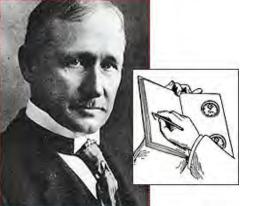
## Conflict Theory – Marxian CMMI Implications

- Companies have established Mandatory Policies, Procedures, & Work Instructions to comply with the CMMI that Rigidly Control Engineering Processes & Product Development
  - "The boss imposes the kind of work, the method, and the rhythm ..."
- Management has usurped Engineering Creativity
  - "The deepest essence of man, his creative act, has been transformed into a possession."



## Frederick Winslow Taylor's **Scientific Management**

- Introduced many of the <u>Alienation</u> Methods that Karl Marx Warned about:
  - Pushed the Division of Labor to the Extreme
    - Decomposed the work process into fragmented assembly line tasks that separated the mental concept of product creation from the physical act of product creation
    - Claimed the mental act of creation for management & relegated the physical act of production to the worker
    - Management usurped the master craftsmen's knowledge, documented it, codified it via work sheets for unskilled workers to follow, & eliminated the master craftsmen



## Frederick Winslow Taylor's Scientific Management

- Used <u>Scientific Management Principles</u> to Maximize <u>Management Control</u> of the <u>Worker's</u> <u>Thinking, Acting, & Doing:</u>
  - Management seized total Control of the Manufacturing Processes, Methods of Product Production, & Workers Mental and Physical Movements
  - Dehumanized, Deskilled and Robotized Workers, which Alienated them from their Work Product, their fellow Workers, & their Families
  - Used Foremen and Industrial & Quality Control Engineers as
     Work Process Cops forcing the Workers to blindly follow
     Scripted Processes, Methods, & Task Sheets



# Frederick Winslow Taylor's Scientific Management - CMMI Implications

- Division of Labor has basically occurred in accordance with the CMMI's 22 Process Areas
- Management Control of the Engineer's
   Thinking, Acting and Doing has been achieved via mandatory CMMI driven Policies,
   Procedures, & Work Instructions
- Compliance Verified via: Internal Audits, Process Audits, QA & CM Audits, & CMMI Appraisals



## **Max Weber's Conflict Theory**

- Bureaucratization of Organizations:
  - Provided Management with an Organizational Methodology that aids Decision Making & Maximizes 4 Factors of Business Operation:
    - <u>Efficiency</u> achieved using optimal means (tasks, methods, & processes) to attain desired ends (products)
    - <u>Calculability</u> achieved using quantification of inputs, processes, outputs, resources, & finances
    - <u>Predictability</u> achieved using consistent, uniform production methods & processes
    - <u>Control</u> achieved tightly controlled automated dehumanized processes, feedback systems, & monitoring of work performance



## Max Weber's Conflict Theory – CMMI Implications

- SEI & DoD have confirmed CMMI Assessed Companies Achievement of Weber's 4 Factors of Business Operation & Performance:
  - Greater Efficiency, Calculability, Predictability, & Control
- However, Bureaucratization Impacts (Iron Cage) on Engineers largely Ignored:
  - Job Satisfaction & Job Performance?
  - Loss of Incentive & Motivation?
  - Loss of Creativity?

# CMMI Bottoms-Up Assessment: a Grounded Analysis from the Perspective of Practicing Engineers in Defense Engineering

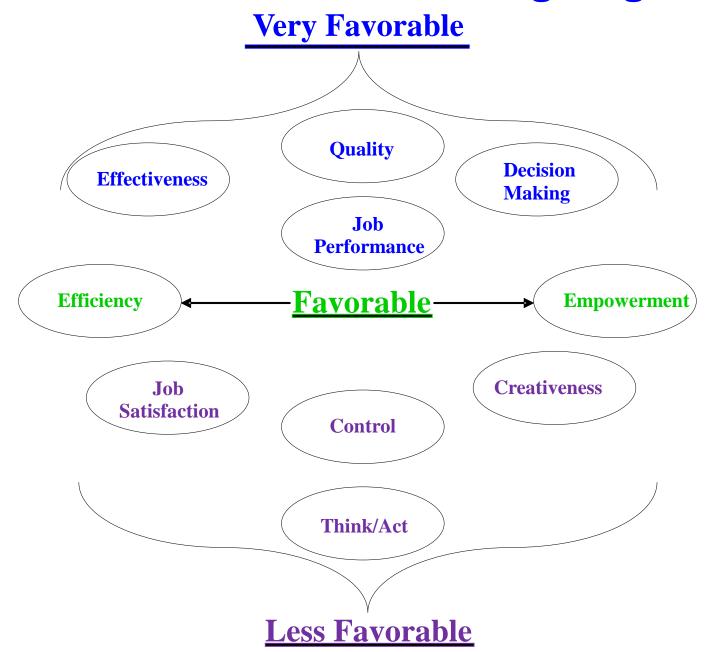


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## **Case Study Background**

- Purpose: Determine how CMMI Practitioners (Engineers)
   viewed the effects of the CMMI on their <u>Job Performance</u> & <u>Job Satisfaction</u> at Defense Engineering (pseudonym)
- Defense Engineering went through 2 CMMI V1.2 Appraisals during this case study period: ML3 & ML5
- Case Study Approach:
  - ❖ <u>12 Engineers</u> (HW, SW, SE, QA) participated in study who had actively implemented CMMI requirements / capabilities on their Projects and participated in CMMI appraisals:
    - ❖ Typical use of CMMI Ranged from 2 to 5 years
    - Engineering Experience Ranged from 9 to 35+ years
  - ❖ <u>Electronic Questionnaire</u> comprised of <u>10 Open-Ended Questions</u>, analyzed & scored responses (Positive = +5, Neutral = 0, Negative = -5), and conducted follow-up discussions with respondents:
    - Used Qualitative and Quantitative Hybrid Analysis Methods
    - Listened to the Voices of Engineers: emails, discussions, & CMMI training sessions

### **How CMMI Affects Practicing Engineers**



## **Voices of Engineers**

- Q1: How does CMMI affect an engineering practitioner's ability to accomplish engineering work tasks <u>effectively</u>?
  - ✓ Results: Positive (P) = 10 {83.3%}, Neutral (N) = 1 {8.3%}, Detrimental (D) = 1 {8.3%}
- R2 [P] "Very positively. There is no longer a question of what is to be done, since it is clearly documented in policies, procedures, and instructions."
- ➤ R6 [P] "Policies, procedures and instructions significantly improved the stakeholder commitment from interdependent teams, resulting in more effective involvement in decisions and tasks that affect them."
- ➤ R9 [D] "In all honesty, I think that the pursuit of CMMI certification, has created such detailed and strict policies, procedures, and reporting requirements that it hinders an engineer's ability to accomplish work tasks effectively, creatively, and efficiently more than it has helped."

#### Q1 – Perform Engineering Tasks Effectively

#### > Positive CMMI Effects

- CMMI specifies what engineering tasks must be done via specific practices (SPs) and generic practices (GPs).
- Company's CMMI Compliant Policies, Procedures, & Instructions (PPIs) specify <u>how</u> these engineering tasks are to be accomplished.

#### **➤ Negative CMMI Effects**

- CMMI may cause companies to implement too many Policies, Procedures, & Instructions (PPIs), which can overwhelm engineers from working effectively by slavishly following these PPIs unless significant tailoring is encouraged & allowed.
- Too many Process Areas (22) and Specific/Generic Goals (116) & Practices (439) that must be implemented, institutionalized, and satisfied to attain CMMI ML5.

- Q2: How does the CMMI contribute to an engineer's ability to create <u>quality</u> engineering products?
  - ✓ Results: Positive (P) = 10 {83.3%}, Neutral (N) = 2 {16.7%}, Detrimental (D) = 0 {0%}
- R2 [P] "Very positively. Of note here is the organizational use of a standard peer review process that has done (in my opinion) the most to enhance the quality of our Engineering Products. Also, standardizing on tools has greatly affected quality."
- R3 [P] "Increased more decisions are made based on data versus engineering judgment, personal agenda, or management decree. There's no question that better processes, when used conscientiously, result in better, higher quality products."
- R5 [P] "Quality has increased Specifically use of peer reviews in a quantitative manner drives up quality."
- ➤ R6 [N] "Quality of the processes and products is ultimately up to the management team. If the management team does not enforce high standards, the quality is shoddy regardless of whether or not policies, procedures, and instructions are being followed."

#### Q2 – Create Quality Products

#### Positive CMMI Effects

- CMMI VER & VAL Ensures building the product right and building the right product.
- CMMI DAR Enables better engineering decisions based upon disciplined, rigorous quantitative analysis.
- CMMI OPD, MA, QPM & OPP Require use of organizational & project data, sharing of measurement data across the organization, and making process/product improvements based upon quantitative data/information.

#### **➤ Negative CMMI Effects**

No Negative Statements Voiced by Engineers.

- Q3: How does the CMMI affect the engineer's ability to accomplish their engineering tasks <u>efficiently</u>?
  - $\checkmark$  Results: P = 7 {58.3%}, N = 3 {25.0%}, D = 2 {16.7%}
- R1 [P] "I think that the main way the CPF [Common Process Framework] has increased my task execution efficiency is with the templates they provide...."
- R2 [P] "Very positively. As personnel move from program to program their learning curve is greatly reduced since tasks are performed consistently and the tool base is relatively the same."
- R9 [D] "We have created an environment where it has become more important and time consuming to show that you have followed the process than it is to do the work and meet the customer's needs."
- ➤ R11 [D] "Our policies, procedures and instructions do not scale to the size of our programs. The process leans toward large programs that can afford the overhead. Small projects gain much less value from the implementation of CMMI."

#### Q3 – Execute Engineering Tasks Efficiently

#### Positive CMMI Effects

- CMMI OPD, DAR, MA, OPP, QPM, VAL, & VER Ensure building the engineering product using standardized organizational templates: plans, test procedures, and reports.
- CMMI DAR Standardized DAR report form used.
- CMMI OPD, MA, QPM, & OPP Require use of organizational & project data, sharing of measurement data across the organization, and making process/product improvement decisions based upon quantitative data/information.

#### **➤ Negative CMMI Effects**

- CMMI has spawned an engineering process that is too burdensome and overly focused on documenting and management reporting.
- Only beneficial to larger projects that can afford the huge reporting/recording overhead.

- Q4: What <u>degree of control</u> does your CMMI compliant policies, procedures and instructions impose on your engineering work activities?
  - $\checkmark$  Results: P = 6 {50%}, N = 2 {16.7%}, D = 4 {33.3%}
- R3 [P] "Higher control is imposed in relation to other non-CMMI organizations where I've worked. This is expected, given the CMMI focus on process repeatability/stability and continuous improvement."
- R10 [P] "The processes are supposed to control all aspects of the engineering activities, and it essentially does except for the human variations that are inevitable."
- ➤ R9 [D] "I would characterize the degree of control that the policies impose to be 'over the top.' We have program reviews, engineering reviews, checkpoint reviews, PAVM [Process Asset Verification Matrix] audits, quality process audits, peer review reporting, weekly team meetings, weekly schedule meetings, monthly measures, QMP [Quantitative Management Plan] measures, EVMS [Earned Value Management System] measures, and the list goes on."

# Q4 – Control Effected Organization's PPIs

#### **≻Positive CMMI Effects**

- CMMI GP 2.8 "Monitor and Control the Process"
- Control is necessary for process repeatability, product consistency, and predictable schedule, cost, & quality results.

#### **➤ Negative CMMI Effects**

 Too much control can be stifling due to layers of approvals and counterproductive due to numerous & burdensome reviews, audits, and meetings that are viewed by some engineers as non-value added.

- Q5: How does the CMMI affect your ability to think and act as an engineer?
  - $\checkmark$  Results: P = 4 {33.3%}, N = 4 {33.3%}, D = 4 {33.3%}
- R7 [P] "CMMI PPI [Policies, Procedures, and Instructions] encourage me to act and think as an engineer. I am exposed to the larger breadth of the program with peer reviews, PACAs [Preventative and Correction Action], and OIDs [Organizational Innovation and Deployment]."
- R6 [D] "Policies, procedures and instructions decrease my creativity and my ability to innovate because they don't challenge me to think up my own solutions. I am provided a template for every task. I am provided a flowchart of process activities that must be followed. I am treated like a cog in a big wheel, without a mind of my own."

# Q5 – Ability to Think & Act as an Engineer

#### **➢ Positive CMMI Effects**

 CMMI helped shape the Common Process Framework used by engineers, which provides them with a defined structure, instructions, and specific processes to follow to create quality engineering products.

#### **➤ Negative CMMI Effects**

• CMMI adoption reduced and stifled engineers' creativity, innovation, and performance due to its burdensome, prescriptive,& bureaucratic processes.

- Q6: How has the CMMI affected your job performance?
  - $\checkmark$  Results: P = 9 {75.0%}, N = 2 {16.7%}, D = 1 {8.3%}
- R5 [P] "They have been useful when I've needed guidance, yet haven't been too restrictive or limiting. Once again, this has been particularly helpful when performing certain duties/tasks for the first time."
- R7 [P] "PPI [Policies, Procedures, and Instructions] aid me in consistently creating quality work products by peer pressure, larger program knowledge by participation in nontraditional disciplines for me."
- ➤ R9 [D] "But if you ask me if I am improving my overall job performance in getting the tasks done and getting quality products out to my customer, I'd have to say that I am a worse performer than historically because of all the process adders I have to do in order to do the same tasks."

### Q6 – Engineer's Job Performance

#### **≻Positive CMMI Effects**

- CMMI based PPIs contribute to:
  - Shorter Learning Curves.
  - Performing Engineering Tasks Consistently & Uniformly.
  - Sharing of Process & Product Improvements across Projects.
  - Common use of Process & Product Measures Information.

#### **➤ Negative CMMI Effects**

- CMMI based PPIs are perceived as detrimental due to the numerous non-value added tasks imposed.
- Large number of PPIs that are invoked on the Project.

- Q7: How has the CMMI affected your job satisfaction?
  - $\checkmark$  Results: P = 6 {50.0%}, N = 3 {25.0%}, D = 3 {25.0%}
- R2 [P] "It has made my job more satisfying. I tend to take a structured approach to tasks and problems which is right in line with the CMMI."
- R3 [P] "It has improved my job satisfaction significantly. ...I prefer working in an environment with clear methods based on best practices and adequate data."
- ➤ R9 [D] "I go home frustrated at the barriers to efficient performance and the total lack of empowerment that I have to make it happen. I have created more documents and minutes and measures in the past several years that no one looks at once they are created."

#### Q7 – Level of Job Satisfaction

#### **≻**Positive CMMI Effects

- Organization's CMMI based PPIs Provide:
  - Structured Approach and Clear Methods for Engineering Tasks.
  - Based upon Best Industry Engineering Practices.
  - Ensures consistent Project Execution across the Organization.

#### **➤ Negative CMMI Effects**

- Organization's CMMI based PPIs have:
  - Diminished Efficiency & Empowerment due to Required Non-Value added Tasks.
  - Hampered Getting High Priority Work Accomplished.
  - Imposed a Significant Overhead Burden on Projects.

- Q8: How has the CMMI affected your <u>decision making</u>?
  - $\checkmark$  Results: P = 9 {75.0%}, N = 3 {25.0%}, D = 0 {0.0%}
- R1 [P] "DARs [Decision Analysis and Resolution] and PACAs [Preventive and Correction Action] are effective tools that allow you to at least partially quantify technical decisions. I have been involved in both DARs and PACAs and think they are effective."
- ➤ R3 [P] "Increased more decisions are made based on data versus engineering judgment, personal agenda, or management decree. There's no question that better processes and better (measurement) data, when used appropriately, result in better, more informed and more valid product decisions."
- R6 [P] "Policies, procedures and instructions helped to lay the foundations for decision analysis and resolution that is based on weighted criteria. Overall the DAR process results in the fairest outcomes."

# Q8 – Decision Making Ability

- **≻Positive CMMI Effects** 
  - Implemented CMMI DAR & CAR Processes:
    - Powerful tools that Facilitate Good Decision Making due to:
      - » Structured Process to follow.
      - » Fairest of Outcomes based on Quantitative Criteria.
      - » Robust Root Cause Analyses & Defect Prevention.

#### **➤ Negative CMMI Effects**

No Negative Statements Voiced by Engineers.

- Q9: How has the CMMI affected your <u>empowerment</u>?
  - ightharpoonup Results: P = 8 {66.7.0%}, N = 1 {8.3%}, D = 3 {25.0%}
- R1 [P] "The ability to tailor is very empowering, if you are willing to do it."
- R4 [P] "The CMMI demands collection of process artifacts and metrics. Development of these items helps structure the thought process and provides a broader view of the product."
- ➤ R10 [D] "I do not believe that empowerment is granted by the process. It seems that the process outlines how engineering decisions are made and who has to approve them. Everything has to be checked/approved by someone else, so consequently I don't feel empowered at all."

### Q9 – Feelings of Empowerment

#### **≻Positive CMMI Effects**

- CMMI Based PPIs Provide:
  - Ability to Tailor Processes & Practices.
  - Use of Integrated Product Teams (IPTs).
  - Collection of Common Artifacts, Measures, and Data.
  - Team Involvement in DAR (Decision Analysis & Resolution)
     Project Decisions.

#### **➤ Negative CMMI Effects**

- CMMI Based PPIs Provide:
  - Fear of Process & Product Audit Noncompliance Findings.
  - Inhibits Empowerment due to Multiple Levels of: Checking, Verifications, and Approvals.

- Q10: How has the CMMI affected your <u>Creativeness</u>?
  - $\checkmark$  Results: P = 7 {58.4%}, N = 1 {8.3%}, D = 4 {33.3%}
- R1 [P] "A frequent criticism that I hear is that they 'limit creativity' ... I do NOT think this is the case, especially with well thought tailoring."
- R7 [P] "Creativity is enhance[d] by exposure to larger scope of program."
- R6 [D] "Policies, procedures and instructions restrict my creativity by not allowing me to try different solutions that I feel would work better."
- R9 [D] "It has stifled it to a great extent. We spend more and more time measuring, documenting, reporting and convincing than we do actually doing the real engineering work."

#### Q10 – Feeling of Creativeness

#### > Positive CMMI Effects

- Tailoring of PPI Processes Enables Creativity.
- Consistent use of PPI Processes allows Creativity in Engineering Solutions.
- Common Process Framework (CPF) Flexibility Encourages Creativity.

#### **➤ Negative CMMI Effects**

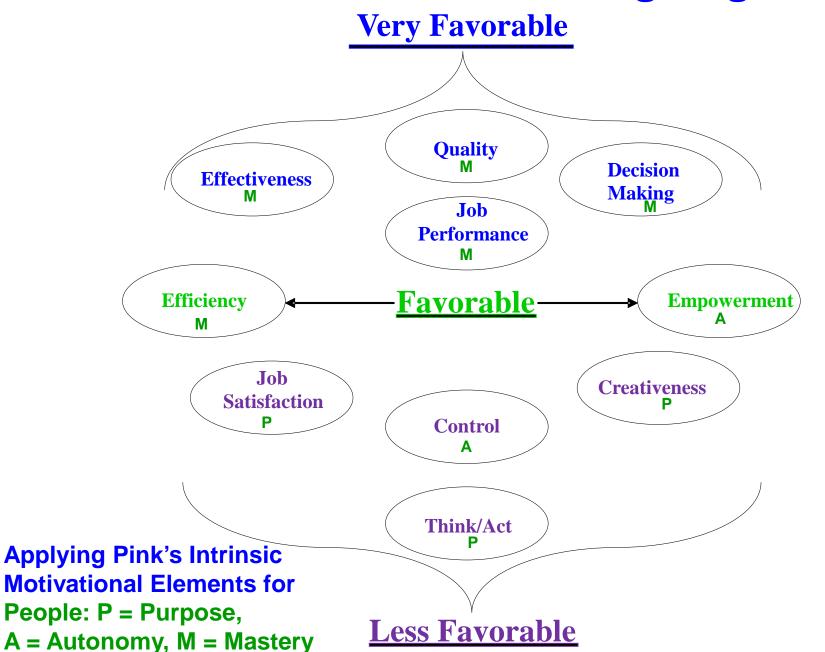
- CPF Restricts use of Non-standard, Different, or Innovative Engineering Solutions.
- Excessive Burden of Measuring, Documenting, & Reporting Stifles Creativity.
- Creativity does not Spring from Process but is Intrinsic to an Engineer.

# CMMI Case Study Conclusions & Recommendations

# **People Implications**

- What Really Motivates People?
- According to Daniel H. Pink "Drive" there are 3 Fundamental Intrinsic Motivational Elements:
  - **➤ Purpose "Live a Life of Purpose"** 
    - Have worthwhile goals to strive for and achieve!
  - > Autonomy "Direct Our Own Lives"
    - ❖Become empowered to think, act, and achieve your goals!
  - ➤ Mastery "Extend and Expand Our Abilities"
    - Have the determination, capacity, and ability to build: capable processes, reliable products, and valuable relationships!

# **How CMMI Affects Practicing Engineers**



### **Conclusions**

- CMMI Suboptimization: CMMI is overly Focused on 1 Element (Process) of Engineering Product Development Framework:
  - ▶ People Execute Processes to Build Products!
  - ▶ People Make Processes Viable & Successful!
  - ▶ People are the Prime Movers & Users of Processes & Technologies!
  - ➤ People → Processes → Technology: Are the CMMI Silver Bullets that Fred Brooks denied, but only when synergistically blended within the organization's Engineering Product Development Framework!

#### Recommendations

- How can we help Engineers (CMMI Practitioners) better <u>Utilize & Practice the CMMI</u> to <u>Improve</u> their <u>Job Performance</u> & <u>Job Satisfaction</u>?
  - ➤ Watts Humphrey → TSP (Team Software Process) → CMMI Practitioners
  - ➤ Agile Processes → CMMI Practitioners
  - ➤ Six Sigma Toolkit → CMMI ML4 & ML5 Practitioners
  - ➤ People CMM → CMMI Practitioners
  - ➤ Daniel Pink ("Drive") understand what Motivates People: Purpose, Autonomy, & Mastery → CMMI Practitioners
  - ➤ Dr. B → Provide Acknowledgement, Recognition, & Appreciation → CMMI Practitioners
  - ➤ Think: People (1<sup>st</sup>) → Processes (2<sup>nd</sup>) → Technology (3<sup>rd</sup>)



# **Backup Slides & Supporting Information**

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# **Case Study Approach & Questions**

# Selected 10 CMMI attributes & assessed how engineers perceived how these attributes affected their job performance and job satisfaction:

- 1. How has the use of your CMMI compliant policies, procedures and instructions affected your ability to accomplish engineering work tasks <u>effectively</u>?
- 2. How has the use of your CMMI compliant policies, procedures and instructions affected the **quality** of the engineering products that you create?
- **3.** How has the use of your CMMI compliant policies, procedures and instructions affected your ability to accomplish engineering work tasks **efficiently**?
- **4.** How would you characterize the <u>degree of control</u> that your CMMI compliant policies, procedures and instructions impose on your engineering work activities?
- **5.** How have your CMMI compliant policies, procedures and instructions affected your ability to **think and act as an engineer**?
- **6.** How have your CMMI compliant policies, procedures and instructions affected your **job performance**?
- **7.** How have your CMMI compliant policies, procedures and instructions affected your **job satisfaction**?
- 8. How have your CMMI compliant policies, procedures and instructions affected your ability to make valid engineering product decisions?
- 9. How have your CMMI compliant policies, procedures and instructions affected your empowerment to make good engineering decisions?
- 10. How have your CMMI compliant policies, procedures and instructions affected your creative ability in doing your engineering work tasks?

# Case Study Approach Scoring

- Engineers' <u>attitudes or feelings</u> about a CMMI factor were grouped into 3 response categories: Positive (P), Neutral (N), & Detrimental (D). These categories have the following meanings & values:
  - "P" means that this CMMI attribute has a strong perceived positive, constructive, and desirable effect on the respondent's work activities (cognitive and / or behavior). Assigned value = +5.
  - "N" means that this CMMI attribute has virtually no perceived effect (i.e. Neutral) on the respondent's work activities (cognitive and / or behavior). Assigned value = 0.
  - "D" means that this CMMI attribute has a strong perceived detrimental, negative, or undesirable effect on the respondent's work activities (cognitive and / or behavior).
     Assigned value = -5.

#### **Table 2 – Rank Ordering of CMMI Attributes Matrix**

| CMMI Attribute         |          |            |            |           | T  |              |    |              |              |     |     |     |       |
|------------------------|----------|------------|------------|-----------|----|--------------|----|--------------|--------------|-----|-----|-----|-------|
| Questions & Rank /     |          | 7          | m          | 4         | w  | و ا          | _  | <sub>∞</sub> | 6            | R10 | R11 | R12 | Value |
| Respondents            | <b>R</b> | <b>R</b> 2 | <b>B</b> 3 | <b>R4</b> | R5 | R6           | R7 | <b>R8</b>    | 8            | ~   | ~   | ~   |       |
| Q2:                    | P        | P          | P          | N         | P  | N            | P  | P            | P            | P   | P   | P   |       |
| Quality                | 5        | 5          | 5          | 0         | 5  | 0            | 5  | 5            | 5            | 5   | 5   | 5)  | 50    |
| Rank = 1               |          |            |            |           |    |              |    |              |              |     |     |     |       |
| Q1:                    | P        | P          | P          | P         | P  | P            | P  | P            | D            | N   | P   | P   |       |
| <b>Effectiveness</b>   | 5        | 5          | 5          | 5         | 5  | 5            | 5  | 5            | -5           | 0   | 5   | 5   | 45    |
| Rank = 2               |          |            |            |           |    |              |    |              |              |     |     |     |       |
| Q8:                    | P        | N          | P          | P         | P  | P            | P  | P            | N            | P   | N   | P   |       |
| <b>Decision Making</b> | 5        | 0          | 5          | 5         | 5  | 5            | 5  | 5            | 0            | 5   | 0   | 5   | 45    |
| Rank = 2               |          |            |            |           |    |              |    |              |              |     |     |     |       |
| <b>Q6:</b>             | N        | P          | P          | P         | P  | P            | P  | P            | D            | N   | P   | P   |       |
| Job Performance        | 0        | 5          | 5          | 5         | 5  | 5            | 5  | 5            | -5           | 0   | 5   | 5   | 40    |
| Rank = 3               |          |            |            |           |    |              |    |              |              |     |     |     |       |
| Q3:                    | P        | P          | N          | N         | P  | N            | P  | P            | D            | P   | D   | P   |       |
| Efficiency             | 5        | 5          | 0          | 0         | 5  | 0            | 5  | 5            | -5           | 5   | -5  | 5   | 25    |
| $\mathbf{Rank} = 4$    |          |            |            |           |    |              |    |              |              |     |     |     |       |
| Q9:                    | P        | P          | P          | P         | P  | D            | P  | P            | D            | D   | N   | P   |       |
| Empowerment            | 5        | 5          | 5          | 5         | 5  | -5           | 5  | 5            | -5           | -5  | 0   | 5   | 25    |
| Rank = 4               |          |            |            |           |    |              |    |              |              |     |     |     |       |
| Q7:                    | N        | P          | P          | N         | P  | P            | P  | P            | $\mathbf{D}$ | D   | D   | N   |       |
| Job Satisfaction       | 0        | 5          | 5          | 0         | 5  | 5            | 5  | 5            | -5           | -5  | -5  | 0   | 15    |
| Rank = 5               |          |            |            |           |    |              |    |              |              |     |     |     |       |
| Q10:                   | P        | P          | N          | P         | P  | $\mathbf{D}$ | P  | P            | $\mathbf{D}$ | D   | D   | P   |       |
| Creativeness           | 5        | 5          | 0          | 5         | 5  | -5           | 5  | 5            | -5           | -5  | -5  | 5   | 15    |
| Rank = 5               |          |            |            |           |    |              |    |              |              |     |     |     |       |
| Q4:                    | P        | P          | P          | D         | D  | D            | N  | P            | D            | P   | P   | N   |       |
| Control                | 5        | 5          | 5          | -5        | -5 | -5           | 0  | 5            | -5           | 5   | 5   | 0   | 10    |
| Rank = 6               | 1        |            |            |           |    |              |    |              |              |     |     |     |       |
| Q5:                    | N        | N          | N          | P         | N  | D            | P  | P            | D            | D   | D   | P   |       |
| Think & Act            | 0        | 0          | 0          | 5         | 0  | -5           | 5  | 5            | -5           | -5  | -5  | 5   | 0     |
| <b>Rank</b> = <b>7</b> |          |            |            |           |    |              |    |              |              |     |     |     |       |
| Algebraic Totals       | 35       | 40         | 35         | 25        | 35 | 0            | 45 | 50           | -35          | 0   | 0   | 40  | 270   |

# CMMI (V1.2) - 5 Maturity Levels

Totals:116 Goals (SG + GG) & 439 Practices (SP + GP)

| Maturity Lev                | el Focus  | 22 Process Areas   | Quality |
|-----------------------------|---|--|---------|
| 5 Optimizing                | Continuous Process Improvement & Defect Prevention [2]  | (OID) Organizational Innovation and Deployment (CAR) Causal Analysis and Resolution  |         |
| 4 Quantitatively<br>Managed | Quantitative<br>Management [2]  | (OPP) Organizational Process Performance (QPM) Quantitative Project Management   |         |
| 3 Defined                   | Engineering<br>& Organization<br>Process<br>Standardization –<br>Qualitative<br>Management [11] | (RD) Requirements Development (TS) Technical Solution (PI) Product Integration (VER) Verification (VAL) Validation (OPF) Organizational Process Focus (OPD) Organizational Process Definition + IPPD (OT) Organizational Training (IPM) Integrated Project Management + IPPD (RM) Risk Management (DAR) Decision Analysis and Resolution |         |
| 2 Managed                   | Basic<br>Project<br>Management [7]  | (RM) Requirements Management (PP) Project Planning (PMC) Project Monitoring and Control (SAM) Supplier Agreement Management (MA) Measurement and Analysis (PPQA) Process and Product Quality Assurance (CM) Configuration Management   |         |
| 1 Initial                   | Ad Hoc &<br>Chaotic [~0]  | Few Processes Documented or Followed – Land of the "Cowboys & Cowgirls" – "Don't Need No Stinking Processes!"  | Risk    |





# Process Improvement by the Numbers

Debra Perry and Jim Goss Harris Corporation November 17, 2010

#### Providing Value To Our Customers

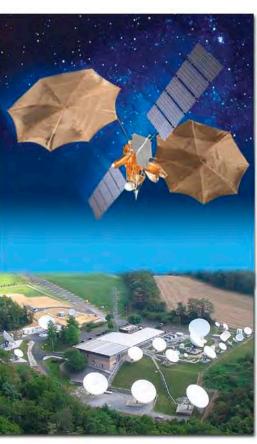




**Industry-leading avionics** 



Intelligence, surveillance, and reconnaissance



Space and ground satellite communications systems



Communications and information networks



**Operations and support services** 

Mission Critical Solutions. Anytime. Anywhere.

#### Agenda



- Background
- Lean Six Sigma
- Situation
- Process
- Results
- Conclusion
- Suggestion

#### Background



- Process Improvement is a learned skill
- To increase awareness and capabilities Harris adopted Lean Six Sigma (LSS)
  - Encourages team members to look for ways to improve processes by
    - Quantifying the process
    - Recommending a change
    - Measuring the improvement
  - Teaches skills to assist in the efforts
    - Lean Fundamentals eliminate waste
    - Simulation understand system performance
    - Change behavior people skills
    - Six Sigma tools statistical skills to reduce variability

#### Lean Six Sigma is



A set of principles, concepts, and techniques designed to enable key processes to produce an optimum system that will deliver to our customers:

**Exactly** what they need

When they need it

In the quantity they need

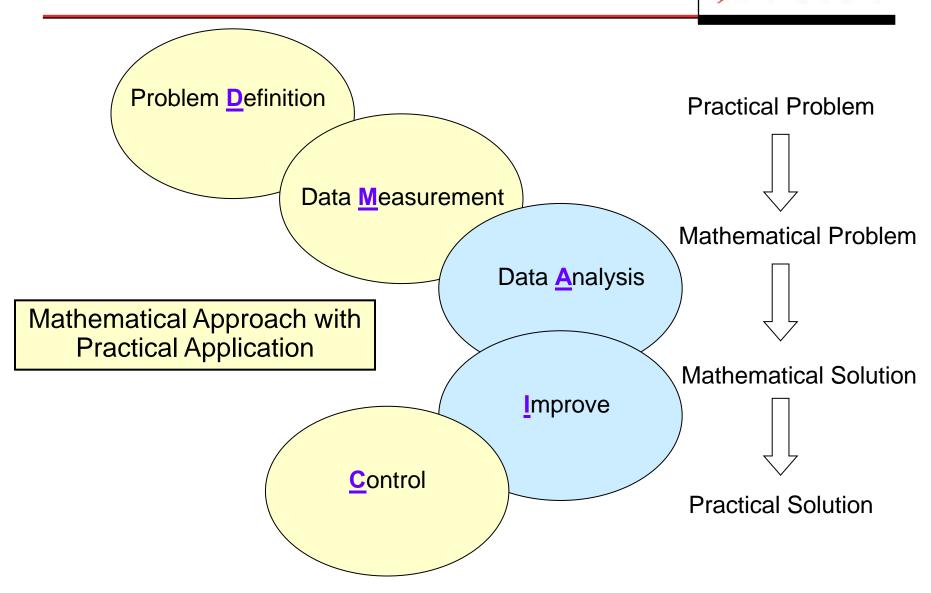
In the right sequence

Without defects

And at the lowest possible cost

#### Lean Six Sigma DMAIC Process





#### Challenge



- To become LSS Green Belt certified requires two process improvement projects
- What steps were used to identify the projects:
  - Investigate areas where processes are repeated and used by more than one person
  - Apply Lean Six Sigma principles to areas where you currently work
  - Investigate ways to reduce waste in processes
  - Investigate ways to take less time to accomplish a task without losing quality
- Division Process Group (DPG) is responsible for maintaining the Division Program Review Template (PRT), investigate ways to improve that process



- Policy requires programs to prepare an extensive package for Program Reviews (PR) each month
- Problem Statement
- PR preparation is 4 8 hours per program per month per Program Finance Analyst (PFA): ~7200 hrs/yr (~100 program \* 12 months \* 6 hours per month)
- Goal
- Reduce PFA PR preparation effort by 30%
- Measurement
- PFA PR preparation effort
- Benefits
- Reduced program cost



- A Business Intelligence Solution would be more elegant
  - Collect all data in a Data Warehouse
  - Use Business Intelligence Tools to automatically produce dashboards and charts, perform trend analysis across programs at different levels of the company
- Can't invest in a new tool at this time
- Data must be gathered from many different systems and entered manually or cut and paste
- Can we improve the process?

#### Project Context



- Summary evaluation & explanations, accomplishments, milestones and deliveries

- Issues / Actions Objectives / status Opportunities



**Program Manager (PM)** 

- Schedules
- Key events/meetings
- Action items
- Other program specific items



- Headcount
- Contract/Budget data
- MPAR data
- Investment
- Cost (Period & ITD)
- Award Fee Data
- PEM data

PRT

- Supplier data
- Etc.



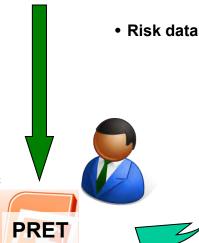




**PeopleSoft™** 

**Program** Logs

- Program Engineering Metrics (PEM) data
- Supplier Summaries
- Materials data





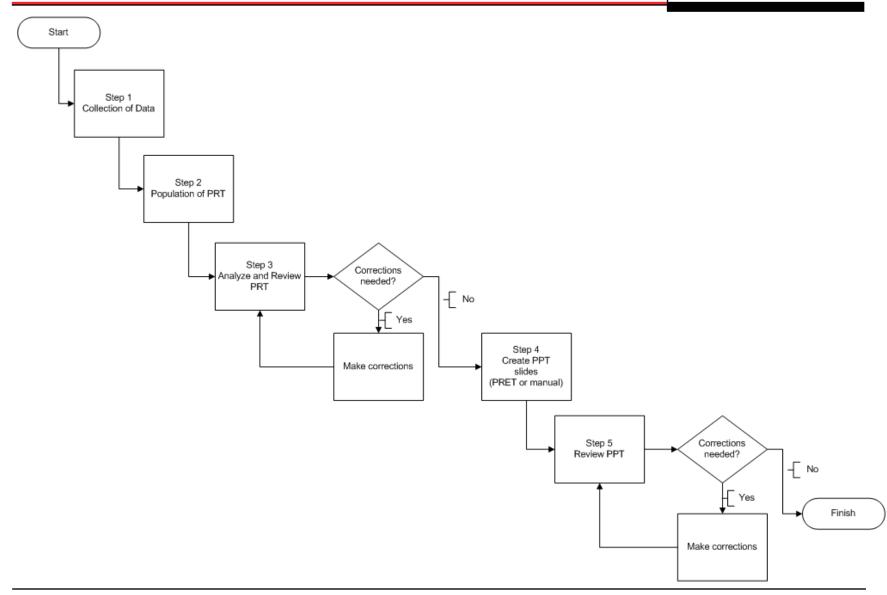
**Program Team** 

PEM Charts



### Process Steps





#### PRT Example



| Program Name: Fictitious          | Cu                    | stomer: NOADIS PA#: 160G Contract Value: \$701,955.5K   |  |  |  |  |
|-----------------------------------|-----------------------|---|--|--|--|--|
| Contract Type: CPAF               | -                     | PM: John Doe TCPI: 1.00 g Available Funds: \$46,317.9K g  |  |  |  |  |
| Contract Start: May-2009          | Contr                 | act End: May-2019 Replan (N) Latest Date: (1) 1/23/2010 Reporting Period: Jul-10                          |  |  |  |  |
| Program Description:              |                       | 10000000  |  |  |  |  |
| Design, Development, and Operate  | e the Ground Se       | gment. Consists of Enterprise Management (NOC), Mission Management (Satellite Command & Control), Product |  |  |  |  |
| Generation (Data Processing), and | Product Distribu      | tion (Data Distribution).   |  |  |  |  |
|                                   | PM ASSESSMENT         |   |  |  |  |  |
| Key Area                          | Last Mo.   This Mo    | Comments/Explanation  |  |  |  |  |
|                                   |                       | 1   |  |  |  |  |
| Customer Relations                | BB                    | Good. Continue frank and open discussions.  |  |  |  |  |
|                                   | ВВ                    | PD CPI: 1.14 b PD CPI w/o Mtrl: b ITD CPI: 1.03 b ITD CPI w/o Mtrl: b                                     |  |  |  |  |
| Cost Performance                  |                       | Underrun for period mainly due to unplanned summer vacations  |  |  |  |  |
|                                   | <b>b</b> ⇔ <b>b</b> ⇔ |   |  |  |  |  |
|                                   | ВВ                    | PD SPI: 1.00 g PD SPI w/o Mtrl: b ITD SPI: 1.00 g ITD SPI w/o Mtrl: b                                     |  |  |  |  |
| Schedule Performance              |                       | On Track  |  |  |  |  |
|                                   | g⇔g⇔                  | Oll Hack  |  |  |  |  |
|                                   | ВВ                    | <u> </u>  |  |  |  |  |
| Technical Performance             | g ⇔ b ⇔               | Element Specs delivered on-time. SWRRs began on schedule.   |  |  |  |  |
|                                   | A n a                 |   |  |  |  |  |
| Staffing                          | G    G                | Staffing is an track. Future concern is staffing for additional studies, and impost of Antonna award      |  |  |  |  |
| Stanning                          | b û b 1               | Staffing is on-track. Future concern is staffing for additional studies, and impact of Antenna award.     |  |  |  |  |
|                                   |                       | Previous: \$375.4K g Current: \$1,497.7K g  |  |  |  |  |
| PMB Variance at                   | Tance at G G G G      |   |  |  |  |  |
| Completion                        | <b>g</b> ⇔ <b>g</b> ⇔ | RW3/ECP04 planning complete. Bottoms-up EAC delayed until nearer PDR to accommodate AER                   |  |  |  |  |
|                                   |                       | Last QA PCM Audit Aug-2010  |  |  |  |  |
| Quality                           | ВВ                    | Continue to track CARDs (closures slightly ahead of schedule). PCM in green. Yellow continues             |  |  |  |  |
|                                   | N tr N tr             |   |  |  |  |  |
|                                   | ВВ                    |   |  |  |  |  |
| Risk Exposure                     |                       |   |  |  |  |  |
|                                   | <b>b</b> ⇔ <b>b</b> ⇔ | <u> </u>  |  |  |  |  |
|                                   | GG                    |   |  |  |  |  |
| Material                          |                       | No issues.  |  |  |  |  |
|                                   | g⇔g⇔                  |   |  |  |  |  |
| Di                                | !!!                   |   |  |  |  |  |
| Drawings                          | N/A N/A               |   |  |  |  |  |
|                                   |                       |   |  |  |  |  |

#### Initial Assessment



#### Initial Projected Statistics

- Initial DPMO: 5000
- Current: 6 hours \* 60 min = 360 min
- Desired: 3 hours \* 60 min = 180 min
- 360 180 = 180
- (180 min \* 1,000,000)/(100 programs\* 360 min) = 5000
- Estimated COPQ: \$126K
- 3 hours \* \$35/hour = \$105
- \$105 \* 12 months \* 100 programs = \$126K

#### Target Projected Statistics

- DPMO Reduction Goal: 30 %
- Target DPMO: 2000
- 30% \* 360 min = 108 min
- 180 108 = 72
- (72 \*1,000,000)/(100 programs\* 360 min) = 2000
- Target Savings/Revenue: would be \$76K/year

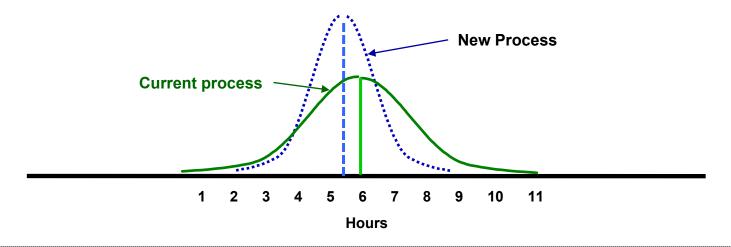
108 min/60min/hr \* \$35/hour \* 12 months \* 100 programs = \$76K

but due to investment cost only \$12K per year - See Slide 17

- Benefit/Assumptions
- More efficient Program Review preparation process

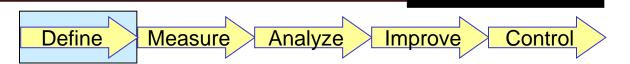


#### **Program Review Preparation Process**



#### Brainstorming



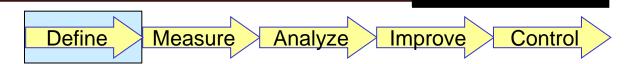


- Facilitated two PFA Round Tables sessions with team resulting in 33 improvement suggestions
  - o Identified 2 possible Lean applications
    - Reduce effort to gather data and populate PRT
    - Reduce number of worksheets being populated
  - o No measurement breakdown available for PRT preparation steps
    - Collection of data
    - 2. Population of PRT
    - 3. Analyze and Review PRT, (correct if needed)
    - 4. Create PPT
    - 5. Review PPT, correct if needed)
  - Need to 'instrument' the process

#### Effort data is currently only verbal estimates

#### Improvement Basis





#### **PRT Improvement Preparation Effort**

- Create PFA Survey to establish baseline preparation times
- Round table indicated 4 8 hours per month preparation
- Approximately 100 programs use PRT each month
- Improvement savings estimate of 30 60 minutes each month per program
- Conservative improvement savings estimate (30 minutes):
  - 0.5 hours \* 12 months \* 100 program \* \$35/hr = \$21K/year
- Expected improvement savings estimate (60 minutes):
  - 1.0 hours \* 12 months \* 100 program \* \$35/hr = \$42K/year
- Aggressive improvement savings estimate (108 minutes) :
  - 1.8 hours \* 12 months \* 100 program \* \$35/hr = \$75.6K/year

Survey to establish baseline and measureable improvement

#### Financial Analysis



| Projected Savings |           |            | Projected Cost |           |         |
|-------------------|-----------|------------|----------------|-----------|---------|
| Labor             |           | \$42K/year | Labor          |           | ~\$150K |
|                   | Equipment | \$0К       |                | Equipment | \$0к    |
|                   | Material  | \$0K       |                | Material  | \$0к    |
|                   | Other     | \$0K       |                | Other     | \$0K    |



Net Projected Savings amortized over 5 years \$42K/year \* 5 years = \$210K \$210K - \$150K = \$60K net savings \$60K/5 years =\$12K annual savings for first 5 years

#### Measurement Data Collected



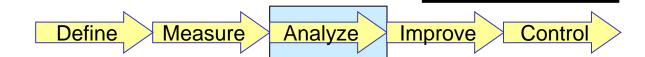
Define Measure Analyze Improve Control

- Drafted Initial PFA Survey
- Anonymous Survey Distributed
  - 200 PFAs received survey
  - 76 responded
  - 51 use the PRT

Good response rate, shows high interest

#### Measurement Data Analyzed





#### • Data indicated:

**Time Spent Collecting Data** 

AVG. 192 min.

STD. DEV. 203 min.

**Number PeopleSoft Reports Generated** 

AVG. 6.5

**STD. DEV.** 2.2

**Time Spent Generating PPT Slides** 

AVG. 41 min.

STD. DEV. 30 min.

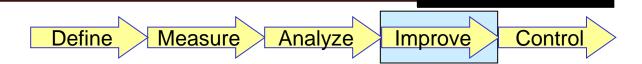
Not all programs are using PRET

**29/47 = 61%** 

#### Data showed room for improvement

#### Planned Improvement Effort



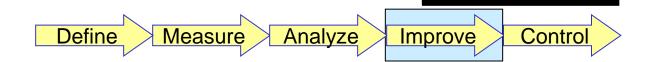


- Process Improvement Project submitted and funded
- Create Working Group with PFAs, PeopleSoft Engineers and Improvement Engineers to:
  - -Create automatic PeopleSoft Import function for PRT
  - -Update documentation (Program Review Instructions Manual)
  - -Create roll out training
- Other improvements:
  - Update PRET
  - Delete unused worksheets in PRT
  - Improve PRT analysis capability, remove indirection

Pilot Programs Liked Improvement

#### Worked Improvement Effort





- Updated PRT, PRET and documentation
- Created training, PFAs to present training
- Piloted new process with 6 programs
- Improvement demonstrated
- Rolled out process to division (166 trained)
- New process in use for several months
- Anonymous Follow up survey distributed
  - 200 PFAs received survey
  - 23 responded
  - 19 use the PRT

#### Response rate much lower



| Define | Measure | Analyze Im | prove | Control |
|--------|---------|------------|-------|---------|
|        |         |            |       |         |

#### Follow-up Survey data analyzed

• Data indicated:
NEW (OLD)

**Time Spent Collecting Data** 

AVG. 100 min. (192 min.)

STD. DEV. 79 min. (203 min.)

**Number PeopleSoft Reports Generated** 

AVG. 4.2 (6.5)

STD. DEV. 3.2 (2.2)

**Time Spent Generating PPT Slides** 

AVG. 68 min. (41 min.)

STD. DEV. 65 min. (30 min.)

Not all programs are using PRET

**14/18 = 78% (29/47 = 61%)** 

#### PFA Data Collection Time reduced on average 48%!!

#### Financial Analysis

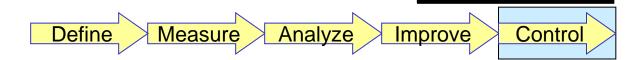


| Actual Savings |           |            | Actual Cost |           |        |
|----------------|-----------|------------|-------------|-----------|--------|
| Labor          |           | \$63K/year | Labor       |           | \$144K |
|                | Equipment | \$0К       |             | Equipment | \$0к   |
|                | Material  | \$0К       |             | Material  | \$0К   |
|                | Other     | \$0K       |             | Other     | \$0K   |



Net Projected Savings amortized over 5 years \$63K/year \* 5 years = \$315K \$315K - \$144K = \$171K net savings \$171K/5 years =\$34K annual savings for first 5 years





- Educate Executive Management, PMs and PFAs on improved process
  - 42 PMs Trained
  - 119 PFAs Trained
  - 5 Others Trained
- Modify expectations for Program Reviews

#### Improvement Sustained

#### Results



- Lean Six Sigma project: SUCCESSFUL!
  - Measurable improvement was achieved for preparation times for Program Review Package
- Improved quality of process a bonus
  - Some programs were not following the standard process in creating their financial data
  - Automating the process flushed out some of the inconsistencies and helped improve understanding and use of the standard process
  - Improved documentation increased understanding
  - Training in the new process pointed out non-standard pitfalls
- Additional improvements were also beneficial

#### Conclusions



- Lean Six Sigma training:
  - Helps people look at things differently and question habits
  - Helps people look for ways to improve how we do business
  - Provides people with tools to enable facilitating change
    - People skills
    - Mathematical skills
    - Modeling skills
    - Increased awareness of available resources
- Supply Chain Operations (SCO) Center for Excellence
  - Provides Lean Six Sigma training
  - Has data to show it pays for itself!

#### Suggestion



- People do not naturally look for process improvement
- People need to be trained to think critically
- If your company is not familiar with Lean Six Sigma processes, you should consider adding them

#### Contact Information



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#### Backup Slides

#### Six Sigma DMAIC Process



- Define the problem, the voice of the customer, and the project goals, specifically
- Measure key aspects of the current process or product and collect relevant data
- Analyze the data to investigate and verify cause-and-effect relationships. Seek out root causes of the defect under investigation
- Improve or optimize the current process or product based upon data analysis using techniques such as design of experiments, poka yoke or mistake proofing, and standard work to create a new, future state process or product. Set up pilot runs to establish process capability
- Control the future state process to ensure that any deviations from target are corrected before they result in defects. Implement control systems such as statistical process control, production boards, and visual workplaces, and continuously monitor the process

#### **Definitions**



- PM
  - Program Manager
  - Responsible for execution and reporting for program
- PR
  - Program Reviews
  - Review of program status with upper management
- PFA
  - Program Financial Analyst
  - Provides financial status for program review package
- PRT
  - Program Review Template
  - Macro enabled Excel spreadsheet that collects PR data
- PRET
  - Program Review Extraction Template
  - Macro enabled PowerPoint file that creates slides from PRT
- LSS
  - Lean Six Sigma

#### More Definitions



#### DPMO

- Defects per Million Opportunities
- A measure of process performance

#### COPQ

- Cost of Poor Quality
- Costs that would disappear if systems, processes, and products were perfect

#### PEM

- Program Engineering Metrics tool
- Web-based tool that collects and reports engineering metrics

#### MPM<sup>TM</sup>

- Deltek MPM™
- Tool for program-based earned value management and reporting

#### ITD

- Inception to Date
- PeopleSoft
  - Oracle financial tool to track labor, costs, etc.

# Turning a Super Tanker: Process Improvement Change at NSA

Steve Tobin, NSA Way Program Manager, DRC Michael Mangieri, NSA Way Project Coach, BTI Sue LaFortune, Government Lead, NSA



## Who is NSA?



- The National Security Agency was established by the Secretary of Defense on November 4, 1952.
- NSA is part of the US Department of Defense
  - The Director of NSA (DIRNSA) is always a general officer of grade O-9 (occasionally higher) from any military service.
  - The Deputy Director of NSA (D-DIR) is always a DoD civilian employee.
- NSA's core missions are to protect U.S. national security systems and to produce foreign signals intelligence information:
  - Information Assurance
  - Signals Intelligence
  - Network Warfare

# Three Key Missions



The Information Assurance mission confronts the formidable challenge of preventing foreign adversaries from gaining access to sensitive or classified national security information.



The Signals Intelligence mission collects, processes, and disseminates intelligence information from foreign signals for intelligence and counterintelligence purposes and to support military operations.



NSA enables Network Warfare operations to defeat terrorists and their organizations at home and abroad.



# NSA's Mission and Systems Development



- The Information Assurance, Signals Intelligence, and Network Warfare missions are highly technical.
  - Systems development and integration—particularly software intensive systems—are a key enabler in fulfilling these missions.
- NSA has many software development projects, ranging from both the very large (100s of developers) to the very small (1−3 developers).

# NSA Process Improvement History



- Early 1990's early 2000's:
  - JACKPOT and Software Engineering Knowledge Base Center
- **2003 2008:** 
  - LIONSHARE
    - One (small) organization achieved CMMI® ML 2 and recently CL 3 in selected Process Areas
  - Six Sigma (and Lean Six Sigma)
- 2008 Present:
  - NSA Way

# What is the "NSA Way"?



"The NSA Way is a unified framework for building large, complex, primarily software systems that meet the diverse needs of NSA missions. It is lightweight, intuitive, and independent of project size and development methodology."

#### It is:

- Based on a Customer/Supplier theme
- Focused on outputs over processes
- About continuous improvement
- Applicable in Agile, Iterative, and Waterfall LCMs
- Independent of team size

# How does NSA Way Fit in NSA?



- NSA Way defines core expectations for how systems and software development are done.
- NSA Way deploys 'coaches' into NSA systems and software development organizations to provide implementation guidance and to assess progress.
- NSA Way is implemented through:
  - Gates (Life cycle control-milestones)
  - Processes (currently there are 7)
  - Metrics (Quality related)
- Driving cultural and behavioral change first, process maturity second

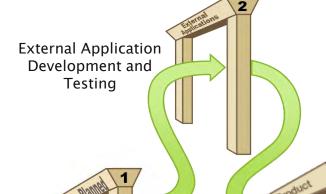
# Contrast Between NSA Way and past NSA PI Initiatives



|  | Examples from Past Initiatives   | NSA Way   |  |
|--|--|---|--|
| Senior Management<br>Support                 | Supported by a 'junior' senior leader who could not influence other key stakeholders. No clear champion other than the sponsor | <ul> <li>Supported at the highest level</li> <li>Championed by senior personnel both within key offices and across the organization.</li> </ul> |  |
| Participation by respected technical leaders | Limited or none  | Developed and supported by some of the organization's technical lead  |  |
| Based on CMMI (or other model)               | Explicitly   | Implicitly  |  |
| Appraisals/<br>Assessments                   | Initial SCAMPI class A appraisal as an   |   |  |

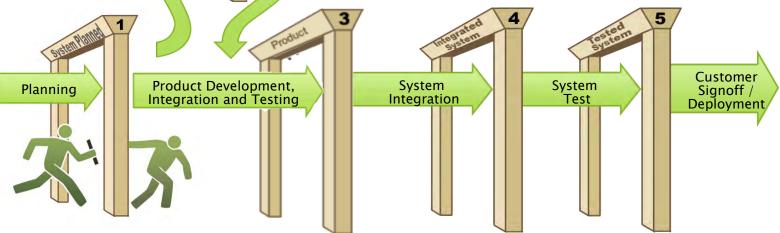
### Gates





Suppliers and customers at each gate

 Gate Criteria represents what the customer needs to be successful



Unit Testing

Code Reviews

**Lessons Learned** 

**Coding Standards** 

Requirements Management

**Configuration Management** 

**Defect Management** 

## NSA Way Required Activities



- 'Establish and maintain ...'
  - Coding Standards
  - Configuration Management Processes
  - Internal and External Interface Specifications
  - Verification processes
    - Conduct code reviews
    - Implement software unit testing
  - Defect Tracking and Reporting System
- Regularly review and improve development and test methodologies

### Metrics



- Philosophy:
  - NSA Way established a set of four focus areas based on key business objectives
    - Time to Field
    - Capabilities Throughput
    - Quality
    - Efficiency
- Projects define their own criteria and measurements to support these goals
  - Gate Pass/Fail data (Time to Field, Throughput, etc.)
  - Code Inspection Data/Unit Test Data (Quality)
  - Customer Satisfaction Survey (Quality)
  - Defect Data (Quality)
  - Program Management Data (Efficiency)

### One Year Later...



- Accomplishments
  - We had plenty
- Challenges
  - OMG!
- Lessons Learned
  - You bet
- Initial Analysis
  - The Good, the Bad and the Ugly

## Accomplishments



- Overall acceptance of the framework
  - Achieved buy-in at all levels: Most senior level to grassroots
  - More than double the number of projects on the framework
  - CMMI-like processes infused without using the 'C' word
- Creation of a common language
  - Lifecycle reference points for managers and developers
  - Expectation of common processes implementations differ
  - Improves cross-project comparisons and mobility
- Importance of the 'coaching' model
  - Coaching model becoming a tool for solving other types of Agency problems
  - Less "business oriented" than a Mentor, broader in scope than a Guru and supported by a coaching network and infrastructure
- Acceptance of key processes and gates

### Challenges



- Getting good data and getting projects to use it.
- Small project teams challenged by 'overhead'
- Our success is hindering us too many projects; too few coaches
- Balance of standardization vs. project's flexibility to tailor implementations
- Middle management acceptance
- Project turnover

### Lessons Learned



- 'Handling required'
- Specialized training had to be created
- Customer-facing infrastructure is important
- Practice what we preach
- Patience goes a long way
  - Pressure leads to Passive–Aggressive behavior
- Tendency to never report failures
  - If it ain't good, don't report it

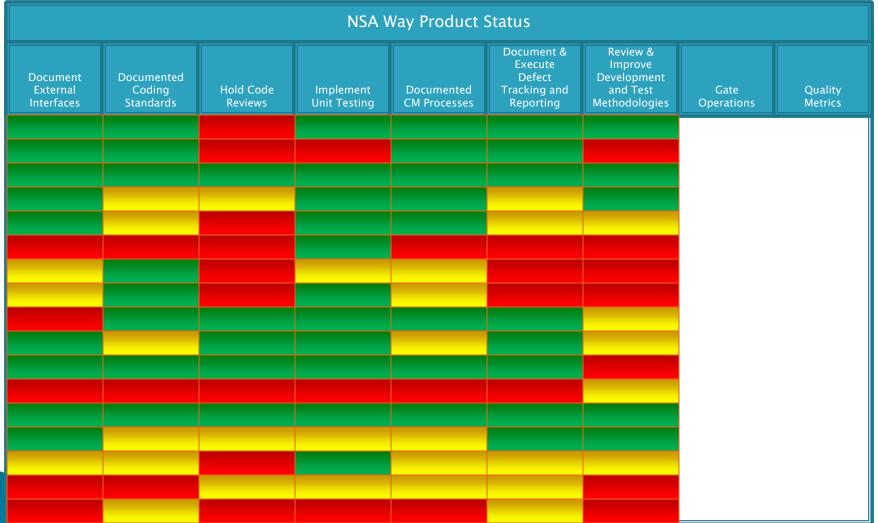
## **Analysis of Data**



- Assessment results
- Defect analysis
  - Cumulative Open–Closed DRs over Spins
- Gate statistics
  - Number of defects by gate over time

### Initial Assessment Summary April 2009





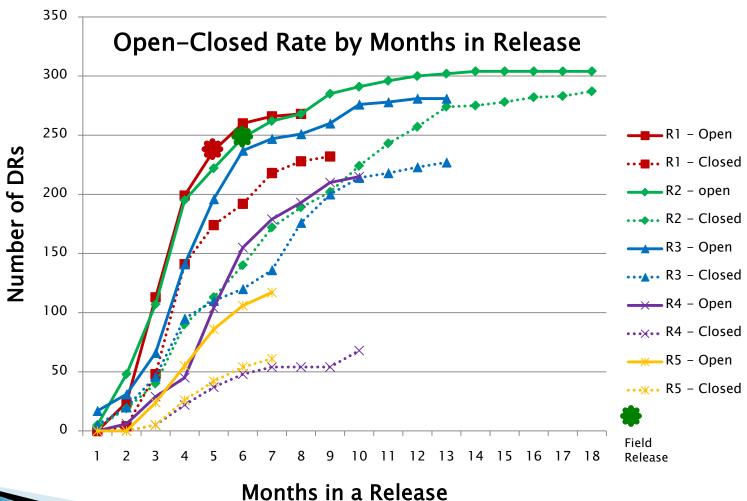
# Final Assessment Summary June 2010



|   |                                    | NSA Way Product Status            |                      |                           |                            |  |   |                    |                    |  |
|---|------------------------------------|-----------------------------------|----------------------|---------------------------|----------------------------|--|---|--------------------|--------------------|--|
|   | Document<br>External<br>Interfaces | Documented<br>Coding<br>Standards | Hold Code<br>Reviews | Implement<br>Unit Testing | Documented<br>CM Processes | Document &<br>Execute<br>Defect<br>Tracking and<br>Reporting | Review &<br>Improve<br>Development<br>and Test<br>Methodologies | Gate<br>Operations | Quality<br>Metrics |  |
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|   |                                    |                                   |                      |                           |                            |  |   |                    |                    |  |
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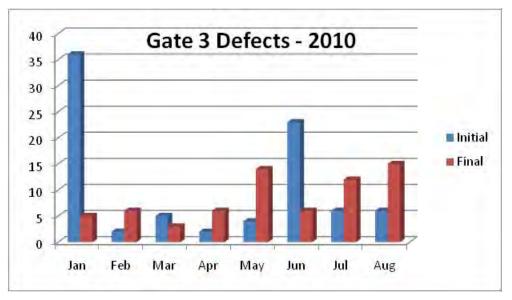
## **Defect Analysis**

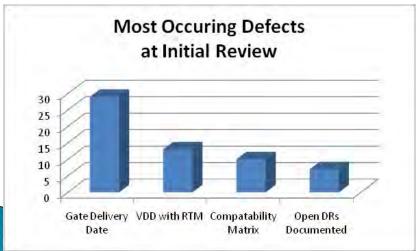


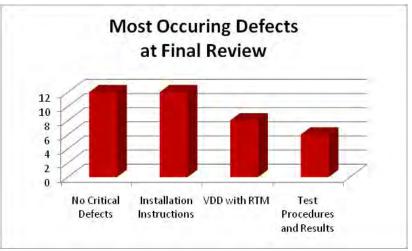


### **Gate Statistics**









## **Future NSA Way Directions**



- Complete rollout across the Technology Directorate and begin expansion beyond
- Encourage teams to go beyond minimum expected behaviors
- Improve data collection
  - Customer satisfaction
  - Lots of other directions we can go...
    - Advanced requirements and defect metrics
    - Time to Market
- NSA Way 2.0 ('Raising the bar')
  - "Depth and Breadth"
  - Integration with other initiatives
  - Learn from 'our' customers and continue to engage the community

### **Contact Information**



- Steve Tobin, Dynamics Research Corporation
  - Email: stobin@drc.com
- Michael Mangieri, Business Transformation Institute, Inc.
  - Email: mmangieri@biztransform.net



# Integrated Management System & CMMI

## CMMI Symposium November 2010

#### Philip Hohn

Value Based Product Development Process Manager ITT ES Phillip.Hohn@itt.com

Engineered for life

#### Steven Axelband

Consultant
Value Based Product Development
Director (retired)
ITT Defense
Steven.Axelband@,msn.com

#### Integrated Management System "Leading Our Business with Purpose"

Value Based Management Establishes Business Strategies



Value Based Product Development Transforms
Strategies Into Product Development Tactics

- Stage Gate
  - Executive direction
  - Resource allocation
- Nimba Value Model focus on Customer Value
- System Engineering
- CMMI best practice processes



Value Based Lean Six Sigma

Measurement and Continuous Improvement

#### CMMI Best Practices Execute VBPD/VBM Policies





### ITT Integrated Management System (IMS)







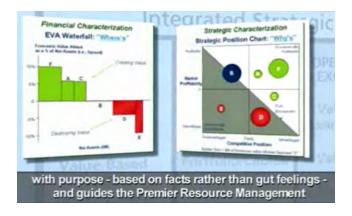


#### **IMS Video Screen shots**

















## CMMI is our Framework for Product Development Within Our IMS Business Framework

IMS Drives
CMMI Best
Practices
Embedded in
VBPD



IMS Drives
Process
Measurement
and
Improvement
Embedded in
VBLSS

- CMMI for Development (CMMI-DEV) provides a comprehensive integrated solution for development and maintenance activities applied to products and services
- CMMI® (Capability Maturity Model® Integration) is a process improvement maturity model for the development of products and services.





#### IMS and CMMI

- **IMS** is an "...integrated, interdependent and iterative framework, guiding our strategic decision making, resource allocation, operational excellence and leadership"
- **CMMI** "processes are planned and executed in accordance with policy; the projects employ skilled people who have adequate resources to produce controlled outputs"
- **IMS** "...guides what we do, measures how well we execute, and creates options for doing even better"
  - "...we embrace the use of the ITT Management System in a disciplined way"
- CMMI "...processes are well characterized and understood, and are described in standards, procedures, tools, and methods





### VBM and Strategic Planning Focuses Value Based Product Development (VBPD)

#### **Integrated Strategic Processes**

PROFITABLE RESOURCE GROWTH OPTIMIZATION

Value-Based
Management

Management

Portfolio Capital
Allocation

OPERATIONAL EXCELLENCE

<u>Value-Based</u> Lean Six Sigma

> Value-Based Goal Department

& LEARNING

Value-Based Leadership Development

Partnership for Performance

#### **Strategic Analysis**



Mergers
Acquisitions
Divestitures

Value-Based

Product

Development,

Plan for Growth

VBPD

New Products with
Unrivaled Customer Value

Lasting Value via Corporate Portfolio Management

Sustainable Profitable Growth

**VBM Strategy Development** 

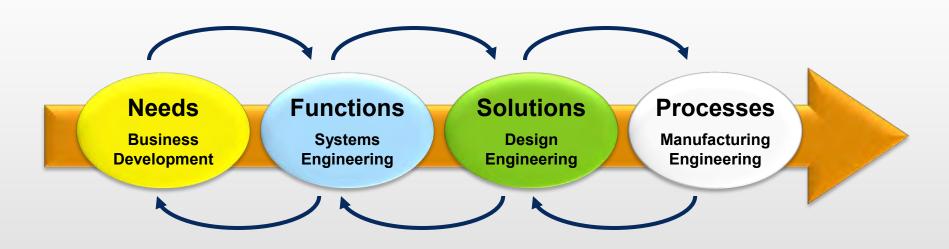
Develops Product Development Strategies to Address Customer Needs





Value Based Product Development

## VBPD Uses the Nimba Value Model to Focus Product Development on Customer Value



**Functions Satisfy Customer Needs** 

Solutions Provide Functions

Processes
Produce Solutions

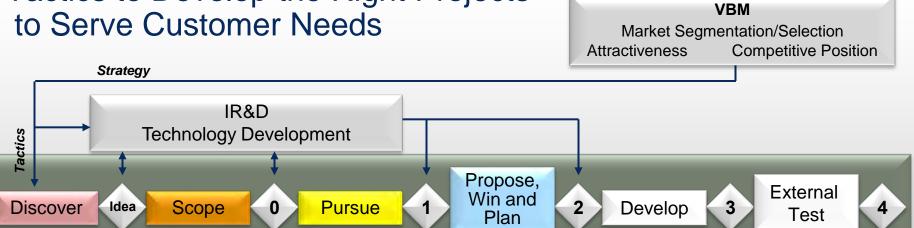
#### VBPD Focuses Products and Services on Customer Value





Stage Gate Within VPBD Transforms Strategy into

Tactics to Develop the Right Projects



Stage Activities develops data required for gate decisions

This is a model *Stage-Gate* process for new Defense Product Development. It is ITT Defense policy that each Value Center adapts a Stage-Gate tailored for their business.

Defense policies imbedded in this process is to establish a process that incorporates "best-in-class" practices for focusing resources on finding, qualifying, pursuing and winning opportunities by:

- Focusing on Gate and Milestone decisions and the information required for the decision
- Coupling resource allocation and expenditures to milestone decisions





Stage Gate Within VPBD Ensures We Select the Right Products **VBM** Market Segmentation/Selection For Development Attractiveness Competitive Position Strategy IR&D **Technology Development** Propose, External Win and 2 Idea 0 Discover Scope Plan Pursue Develop **Test**  $\mathbb{R}$ Detail Proposal Program Propose **Build Capture** Preliminary Capture Program Program Plan Tower Foods 3 Plan Harasett Plan Program Plan Team Plan war bout BD Update Market Analysis Financial Update **Analysis** Needs VOC Concept Development, Develop Engrg Detail Derive **Functional** Needs Trades & Architecture & Requirements & Requirements Trades VOC Design Strategy Selection Management BD Hi-Level Market Analysis VOC Engrg Hi-level Needs Hi-level Regits **Functional Trades** VOC

**Solutions** 

Nimba Value Arrow

**Processes** 

Value

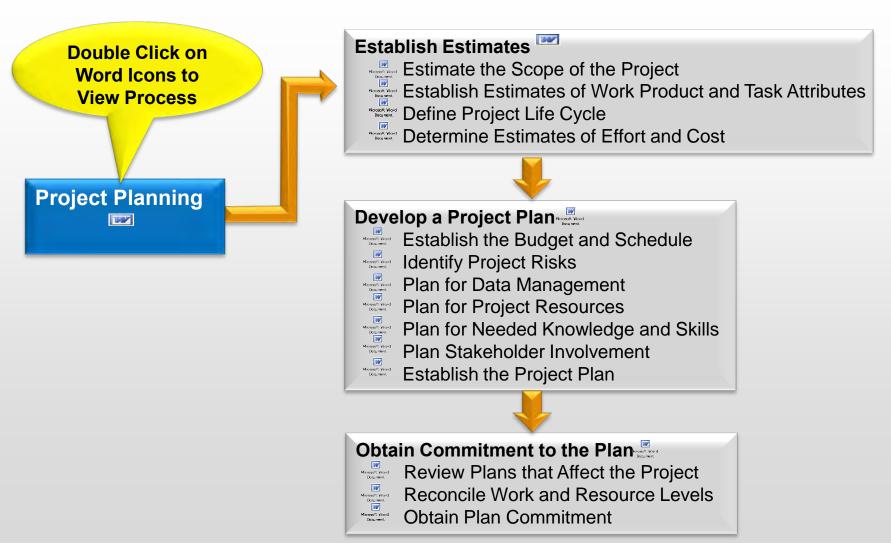
**Functions** 

Needs



Value Based Product Development

#### Apply CMMI Best Practices to Develop the Project Plan

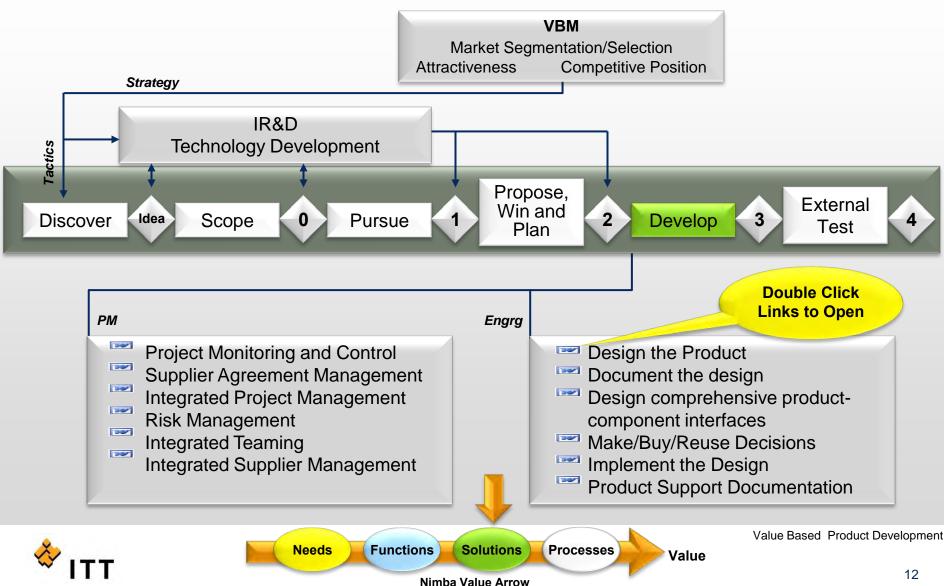






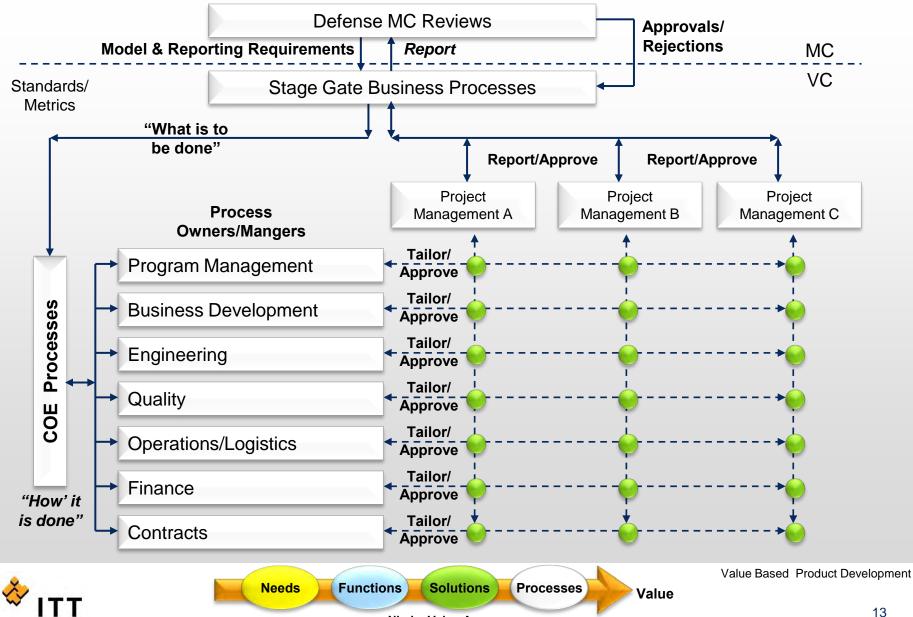
### Stage Gate Ensures We Apply CMMI Best Practices to Develop the Product Right

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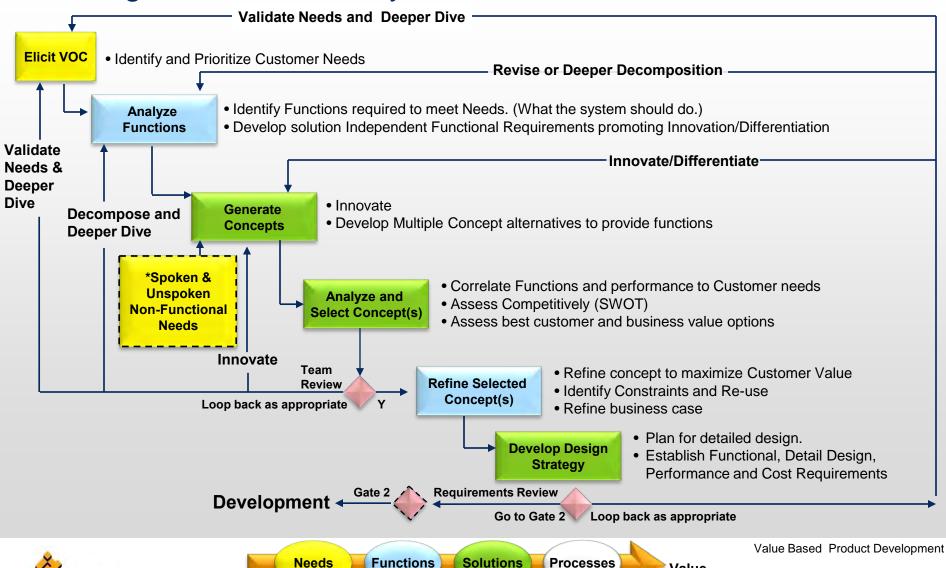
### Processes are Tailored to the Project

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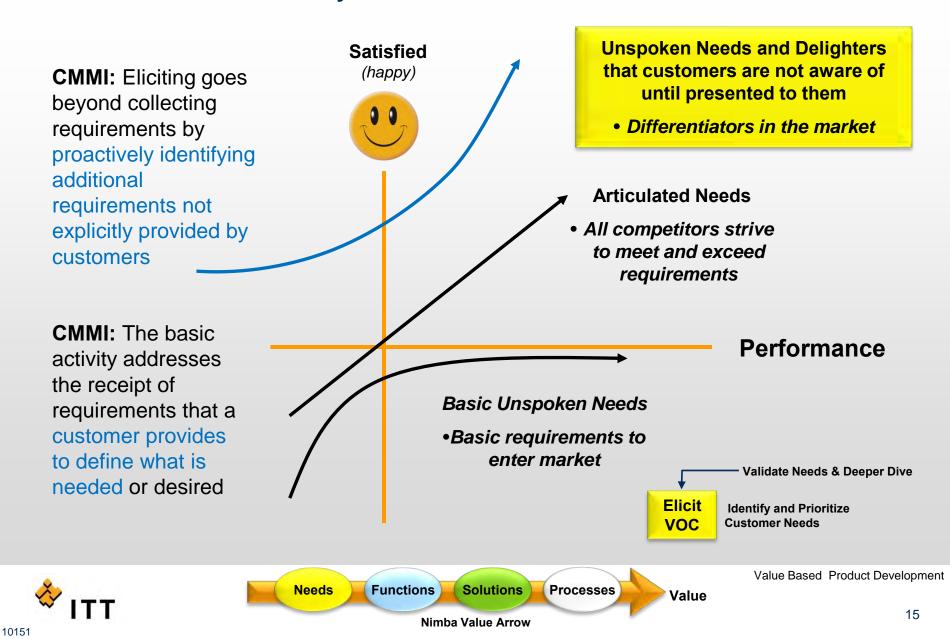


Nimba Value Arrow

### VBPD VOC to Concept Creation and Differentiation Through Functional Analysis



#### **VBPD** Kano Analysis of Needs

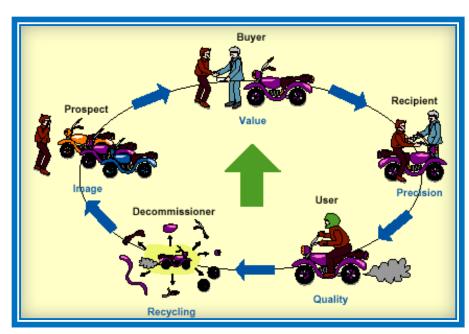


## VBPD Consider All Stakeholders in the Product Life Cycle

cmml: ... these requirements address the needs of relevant stakeholders, including those pertinent to various product life-cycle phases

The Customer Value focus changes during the product life cycle.

Prospects are attracted with image



Taken from "NIMBA Value Model" Chapter 17 page 12

- Customer value is important to buyers
- Recipients value precision in accuracy in response to purchase specifications
- User values quality and performance
- End of Life Decommissioners value recycling to simplify work





## VBPD: Needs are Opportunities Which Should Be Articulated:

- In the language of the customer, not the language of the designers
- In the domain of the customer, not the domain of the product

**CMMI:** The customer requirements may be expressed in the customer's terms and may be non-technical descriptions.

**VBPD:** Independent of a solution (or even the possibility of a solution)

- As a "need to" ....(do something); not as a "need for" ... something
  - A "need for" something implies a solution
- Characterize desired outcome







## VBPD: To Ensure Unrivaled Customer Value in Product Development, Needs Must Be:

- Identified
  - "You can observe a lot just by watching."
- Translated into clear, concise and measurable technical requirements
  - "You've got to be very careful if you don't know where you are going because you might not get there."

**CMMI:** The stakeholder needs, expectations, constraints, interfaces, operational concepts, and product concepts are analyzed, harmonized, refined, and elaborated for translation into a set of customer requirements.





Validate Needs & Deeper Dive

**Identify and Prioritize** 

**Customer Needs** 

Elicit

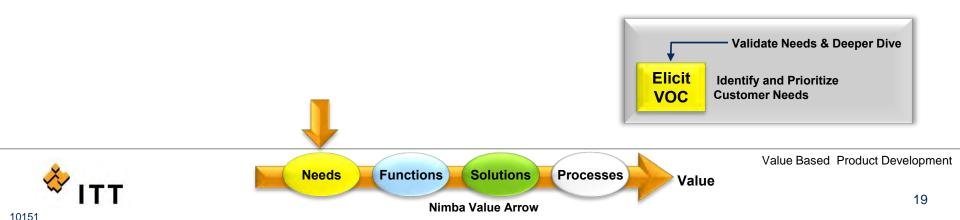
VOC

## VBPD: Needs, Functions and Customer Value Should Drive Concept Selection

"No amount of architectural or detailed design rigor can make up for an inferior concept selection"

**CMMI:** Requirements are the basis for design. The development of requirements includes the following activities:

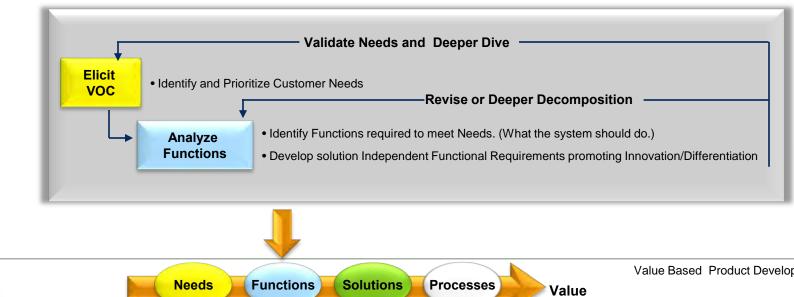
 Elicitation, analysis, validation, and communication of customer needs, expectations, and constraints to obtain customer requirements that constitute an understanding of what will satisfy stakeholders



### **Functional Analysis**

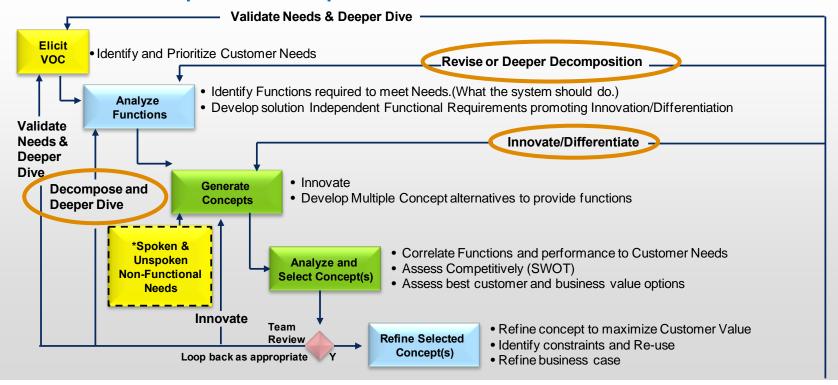
**VBPD:** "to capture the intended behavior of the system"... to satisfy the customer's "need to do something"

**CMMI:** The definition of functionality, also referred to as "functional analysis," is the description of what the product is intended to do.

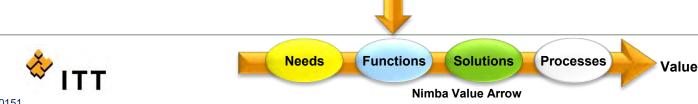


Nimba Value Arrow

#### Recursive and Iterative Functional Analysis and Concepts **VBPD Concept Development**

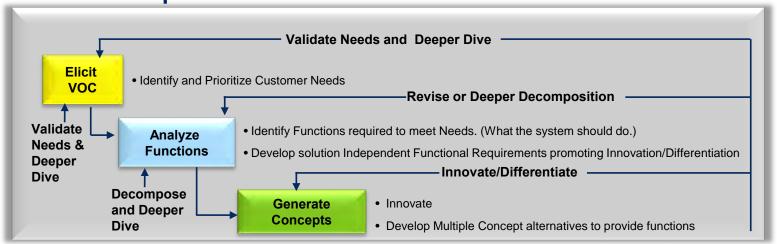


**CMMI** Analyses occur recursively at successively more detailed layers of a product's architecture until sufficient detail is available to enable detailed design, acquisition, and testing of the product to proceed. As a result of the analysis of requirements and the operational concept ... concept(s) produces more derived requirements



Value Based Product Development

## Functional Analysis Drive Solutions and Identifies Interface Requirements



#### **VBPD**

Functional Analysis

- ...Moves our focus from outside the system and what the system is intended to do
- ...to inside the system and begin to specify how it will accomplish its intent

#### **CMMI**

Interfaces between functions (or between objects) are identified. *Functional* interfaces may drive the development of alternative solutions





#### **USE Cases**

**VBPD** ... Study the desired behavior of the product before a solution is developed

**CMMI** ... Typical Work Products

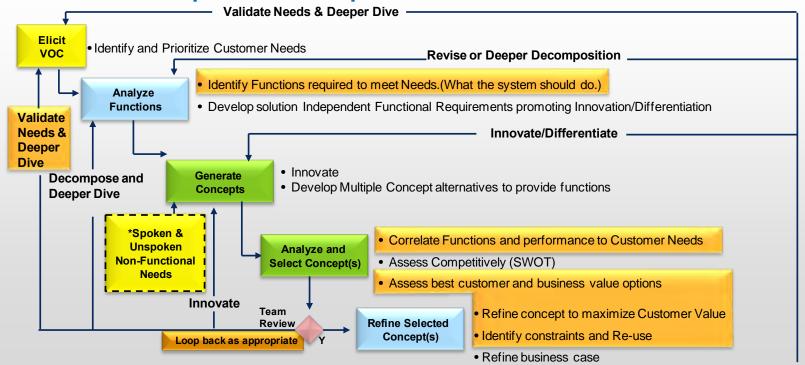
- Timeline analyses of product-component interactions
- Use cases

Analyses are performed to determine what impact the intended operational environment will have on the ability to satisfy the stakeholders' needs, expectations, constraints, and interfaces.



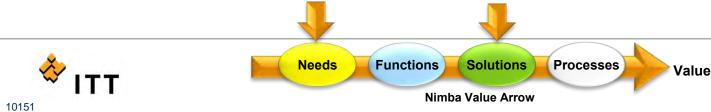


# Analyze and Validate Requirements VBPD Concept Development



**CMMI –** The objectives of the analyses are to determine candidate requirements for product concepts that will *satisfy stakeholder needs*, expectations, and constraints; and then translate these *concepts* into requirements

Requirements are validated to increase the probability that the resulting product will perform as intended in the use environment.



#### Integrated Management System "Leading Our Business with Purpose"

Value Based Management Establishes Business Strategies



Value Based Product Development Transforms Strategies Into Product Development Tactics

- Stage Gate
  - Executive direction
  - Resource allocation
- Nimba Value Model focus on Customer Value
- System Engineering
- CMMI best practice processes



Value Based Lean Six Sigma

Measurement and Continuous Improvement

#### CMMI Best Practices Execute VBPD/VBM Policies





# Architecture for Enterprise Process Improvement

10<sup>th</sup> Annual CMMI Technology Conference and User Group November 17, 2010



Joan Weszka
Lockheed Martin Corporation
Integrated Systems & Global Solutions

#### Agenda

- Context: Problem to be Solved
- Software Architecture Applicability to Process Improvement Architecture
- Project Phases
- Lockheed Martin Operating Excellence
- Summary

November 17, 2010



#### **Context: Problem Definition**

- A process-rich culture bred many process improvement "entities" over a decade+
  - Some vintage from legacy organizations
  - Some spawned to respond to multiple models/standards in an integrated way
  - All great mechanisms but stovepiped!













November 17, 2010

## **Project Sponsored**

- Sponsorship and initiation of a process improvement project:
  - Objective: <u>Improve the Enterprise</u> <u>Process Improvement (PI) Architecture</u>

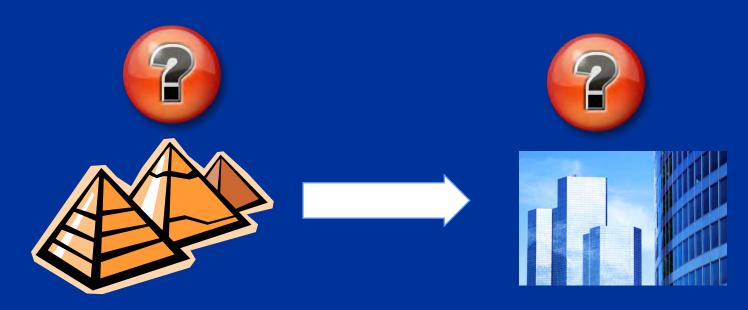






# Defining an Enterprise PI Architecture

- What comprises an enterprise process improvement architecture?
  - Approach taken: leverage concepts from software architecture





- The structure or structures of the system, which comprise the software elements,
- The externally visible properties of those elements and
- The relationships among them\*



# This definition can be applied to an Enterprise Process Improvement Architecture

<sup>\*</sup> Software Engineering Institute Webinar "Software Architecture Fundamentals: Technical, Business, and Social Influences" by Rob Wojcik, July 8, 2010

# **Enterprise Process Improvement Architecture Definition**

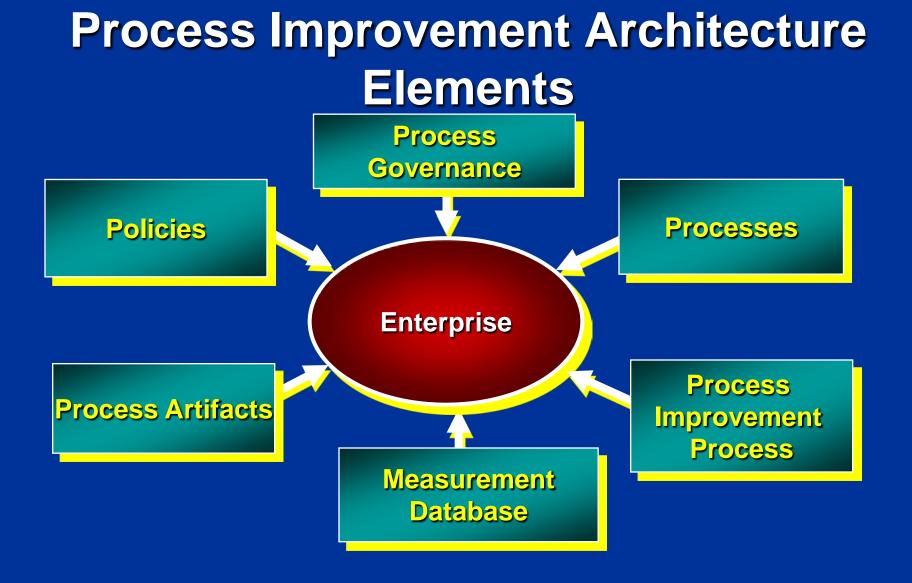
- 4
- The structure or structures of the enterprise, which comprise the process improvement entities\*,
- The externally visible properties of those entities and
- The relationships among them

\* Includes people, processes, policies and tools

## **Software Architecture Principles\***

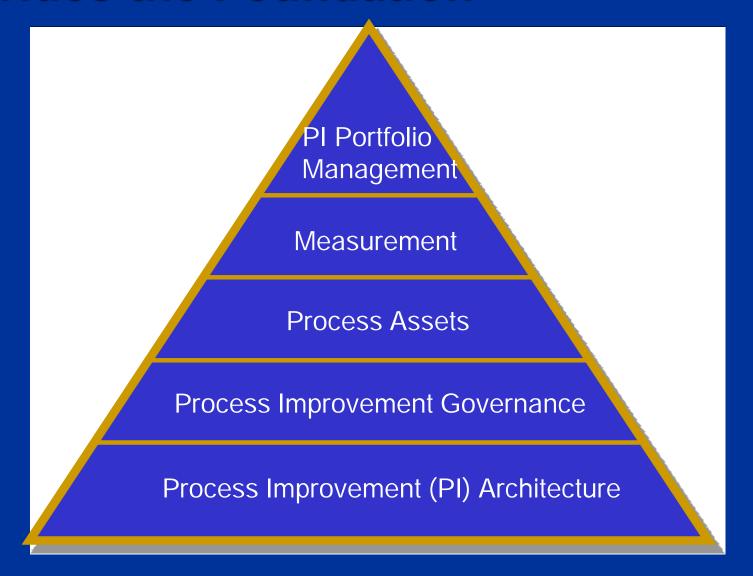
- Architecture abstraction includes all of the "elements"
- Roles, responsibilities, behaviors and properties of the elements are described
- Relationships depicted include those
  - Among elements
  - Between elements and other enterprise activities
- Artifacts provided to and required from elements
- Different views and perspectives available

\* Also apply to an Enterprise Process Improvement Architecture



The Process Improvement Architecture includes everything needed to "operate" process improvement!

# Process Improvement Architecture Provides the Foundation



## **Project Phases**



#### **INVENTORY IMPROVEMENT ACTIVITIES**









#### INVESTIGATE WHAT OTHERS ARE DOING

**CREATE FLOWS OF STATUS QUO** 

RELATE TO OPERATING EXCELLENCE





**ENGAGE ENTERPRISE STAKEHOLDERS** 



COMPILE FINDINGS & RECOMMENDATIONS

**IMPLEMENT RECOMMENDATIONS** 

# Results of Process Improvement Inventory

- Stovepiped activities
- Unintegrated
- Not all are institutionalized
- Nevertheless . . .
  - Significant process improvement underway!



# An Enterprise Process Improvement Architecture has no



So there is considerable work to be done!

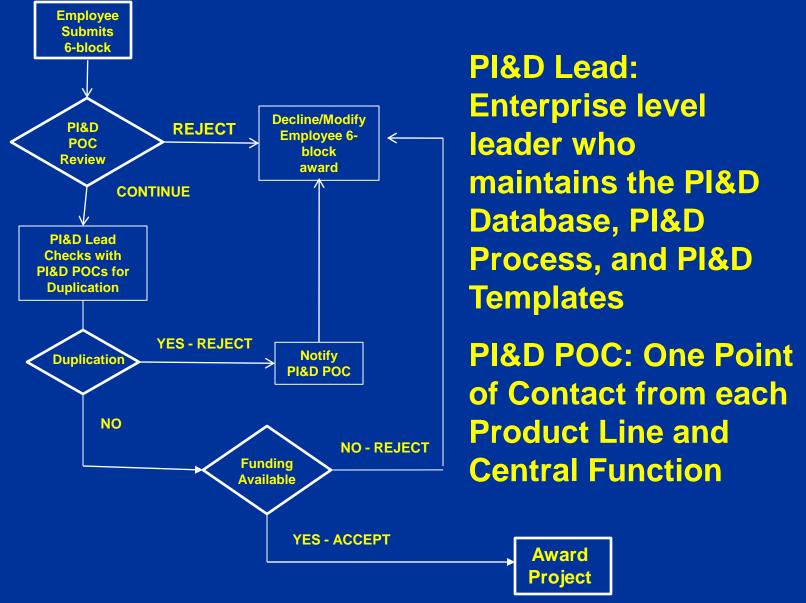
# Tenets from Other Enterprise Process Improvement Activities

- Focus on practices resulting in measurable business improvements
- Establish a process improvement framework
  - GRIP (Growth, Reputation, Innovation, People)
  - Protect/Transition/Grow
- Engage Subject Matter Experts from each business unit
- Follow a business rhythm to establish initiatives and track progress
- Encourage, but don't edict, best practice adoption

Key Practice: Use a feedback loop to guide actions and calibrate whether practices are working

# Process Innovation & Deployment (PI&D) Process Flow - Example





## **Project Phases**





#### **INVENTORY IMPROVEMENT ACTIVITIES**





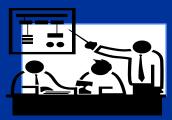




**CREATE FLOWS OF STATUS QUO** 

RELATE TO OPERATING EXCELLENCE





**ENGAGE ENTERPRISE STAKEHOLDERS** 



COMPILE FINDINGS & RECOMMENDATIONS

**IMPLEMENT RECOMMENDATIONS** 



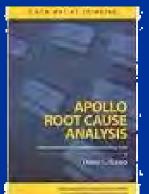


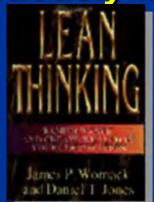


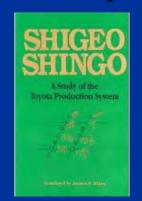
### **Five Principles of Operating Excellence**

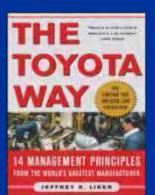
- Specify Value of the product from your Customer's perspective
- Identify the Value Stream for each product
- Enable product to Flow without interruptions
- Allow the customer to Pull value from the producer

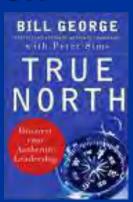
Continuously improve...pursue Perfection



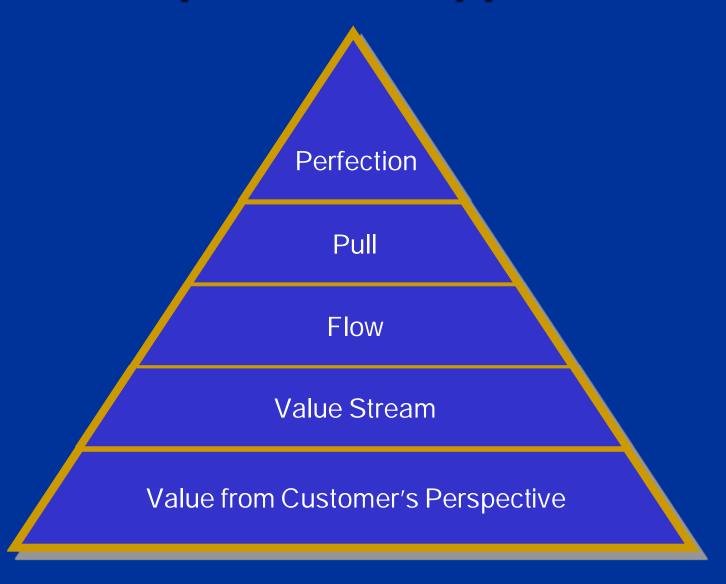








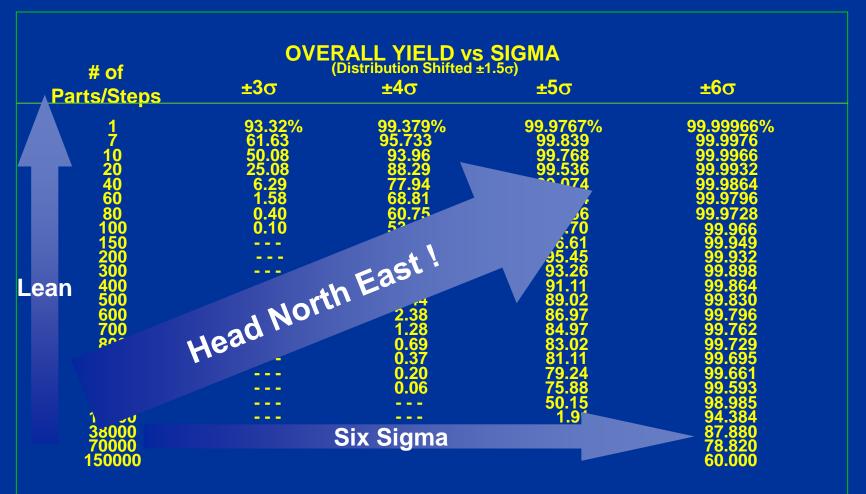
## **Principle Based Approach**



#### **Eliminate Non Value Elements**

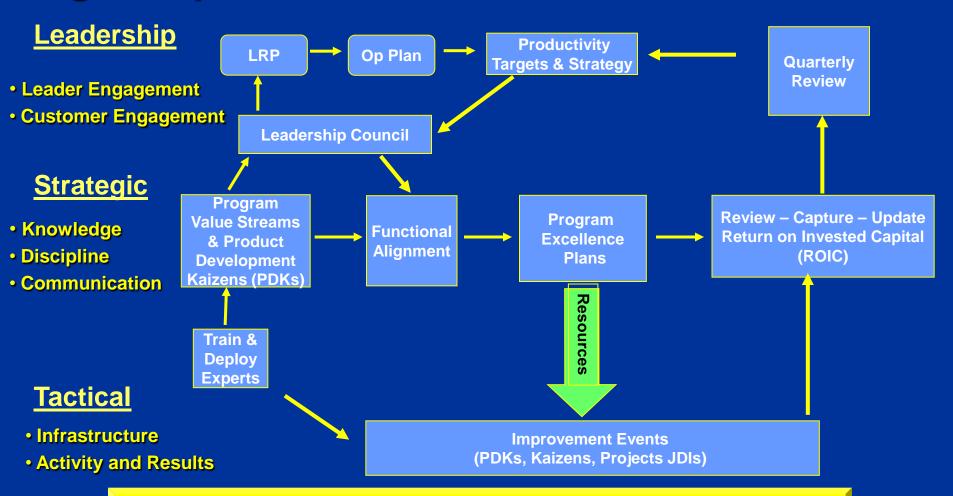
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- Reduce Waste
- Mistake Proofing
- Reduce Variation



20

# LM21 Operating Excellence Logic Map



**Closed-Loop Continuous Improvement** 

## **Project Phases**





#### **INVENTORY IMPROVEMENT ACTIVITIES**









**INVESTIGATE WHAT OTHERS ARE DOING** 

**CREATE FLOWS OF STATUS QUO** 

RELATE TO OPERATING EXCELLENCE





**ENGAGE ENTERPRISE STAKEHOLDERS** 



Here we are!

COMPILE FINDINGS & RECOMMENDATIONS

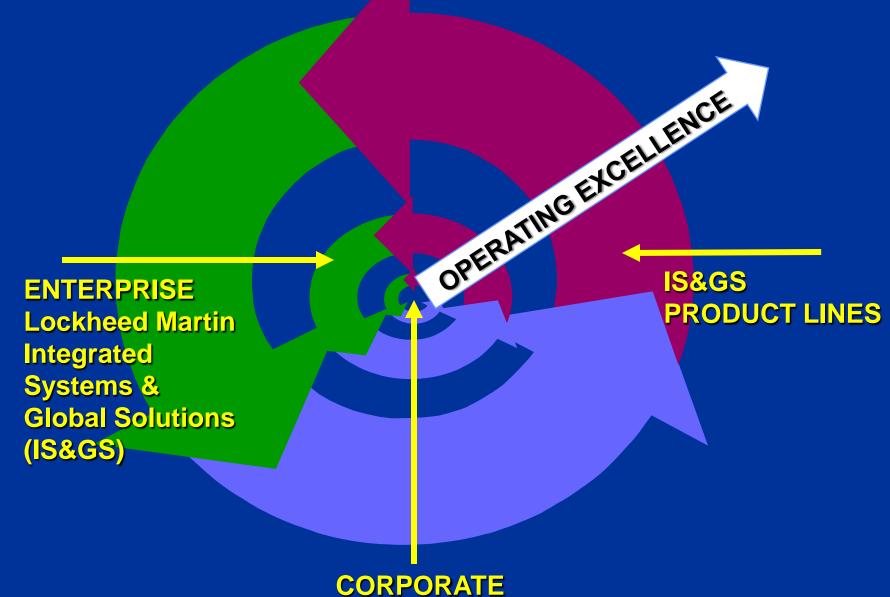
**IMPLEMENT RECOMMENDATIONS** 



- Focusing on Operating Excellence at the enterprise level
  - Ensures practices result in <u>measurable</u> business improvements
  - Provides a <u>business rhythm</u> to establish initiatives and track progress
  - Works by <u>encouraging</u>, not mandating, best practice adoption
- Directives and procedures are useful to flesh out the Operating Excellence process (e.g., in Product Lines)
  - Directives and procedures mapped to the corporate process and ensure integration and completeness

The same Operating Excellence process applies at every level of the corporation

Operating Excellence Deployment at Every Function and Organizational Level in the Corporation



## Summary

- Software architecture concepts apply to the Enterprise Process Improvement Architecture
  - Provide discipline
  - Ensure completeness
- Lockheed Martin's Operating Excellence is a fundamental cornerstone of our business model
  - Applies to process improvement activities at <u>every</u> level
  - Provides a robust tool kit
  - Yields business results!

#### **Contact Information**

1

- Joan Weszka
- Lockheed Martin Information Systems & Global Solutions
  - 301-721-5714
  - Joan.Weszka@Imco.com





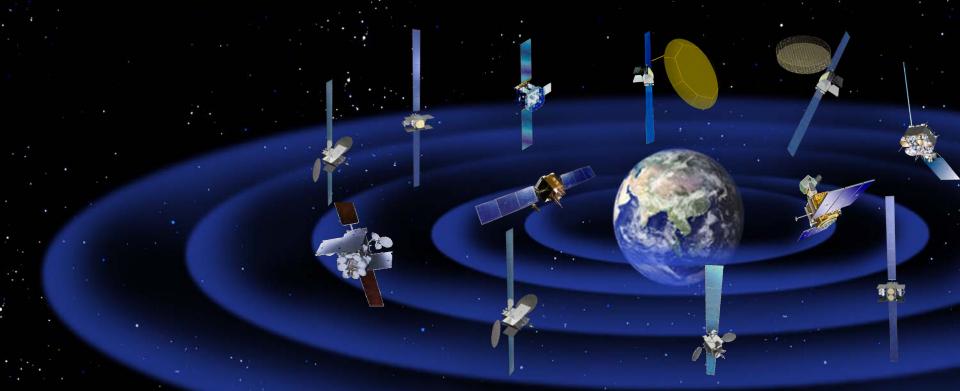
# Using CMMI® to Improve the Enterprise, Not Just its Processes

NDIA 10th CMMI Technology Conference 15-18 November 2010

Philip Wah, Jr.
The Boeing Company
philip.b.wah-jr@boeing.com
310-662-5865

#### Boeing Space and Intelligence Systems (S&IS)

S&IS is Boeing's center for all intelligence and government / commercial space systems. It is the world's leading manufacturer of geostationary satellites, and has the largest dedicated satellite factory in the world. S&IS' headquarters is in Seal Beach, California.



CMMI® Core Team Located in El Segundo, Southern California

# ABSTRACT: Using CMMI<sub>®</sub> to Integrate and Improve the Enterprise, NOT Just its Processes

For some, the <u>CMMI®</u> Journey is about defining, executing and improving processes with the end <u>goal</u> of <u>obtaining a CMMI®</u> rating. Taking this approach usually <u>results</u> with good processes, satisfied process teams, a plaque on the wall and <u>no real perceived value</u>.

This presentation covers how we made <u>high value</u> achievements when <u>renewing our CMMI® rating</u>. This included making significant organizational integration improvements, and fostering a culture that recognizes CMMI makes good business sense.

The <u>key was</u> in <u>creating value propositions</u> using the right people, use cases and tools to facilitate efficient information access. Most importantly, we planned big, started small <u>and</u> had <u>a detailed</u> interpretation and <u>implementation strategy of</u> the <u>CMMI</u>® model.

#### Agenda

- Background Transitioned to strategic CMMI® focus
- High leverage areas for value propositions
  - Appraisal preparation
  - Multi-disciplined problems
  - Use cases
- Critical steps in framing value propositions
- Getting MORE value from CMMI®







#### A Value Proposition is a Proposal that Adds Value

#### Where Have We Been on Our CMMI® Journey?

- Started using CMMI<sub>®</sub> as an improvement tool in early 2000
- Obtained numerous CMM<sub>®</sub> / CMMI<sub>®</sub> Level 3 / 5 ratings
- Received numerous RFPs that have CMMI® requirements
- Transitioned focus from tactical to strategic improvements
  - Broad scope
  - Infrastructure
  - Integration

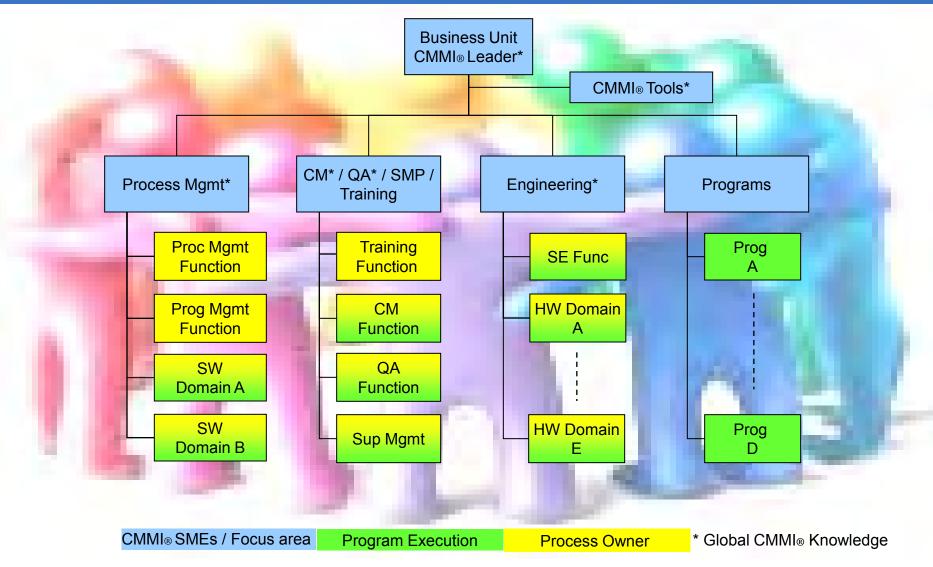






#### Using CMMI® for the Right Reasons!

#### CMMI<sub>®</sub> Transition Team Included all Product Development and Process Management Stakeholders



#### Situation During our CMMI® Transition

- Very challenging business environment
  - Few new programs
  - Extreme competition
  - Focus on bottom line results overhead cutbacks

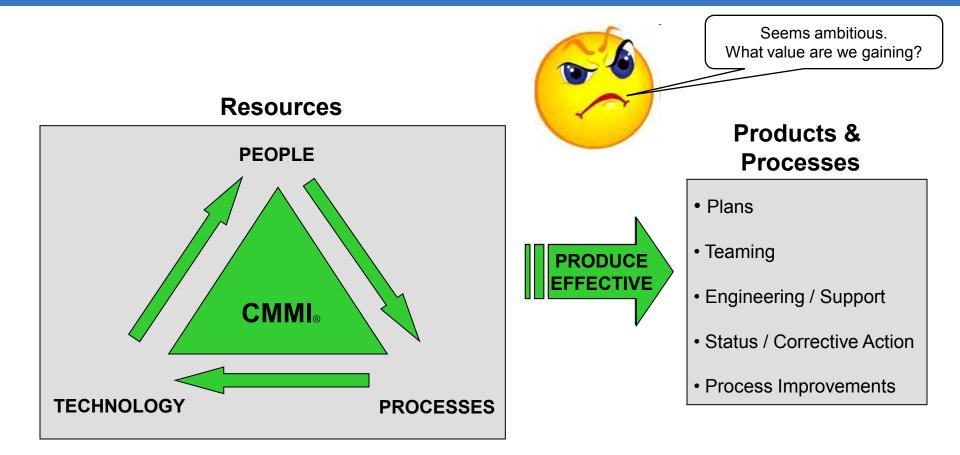


- Significant organizational changes
  - Restructuring and realignment
  - New common processes
  - Aggressive improvement initiatives



#### Climate Focused on Adding Value

#### Described CMMI® to New Management Team



#### Global Nature of Approach Raised Concerns

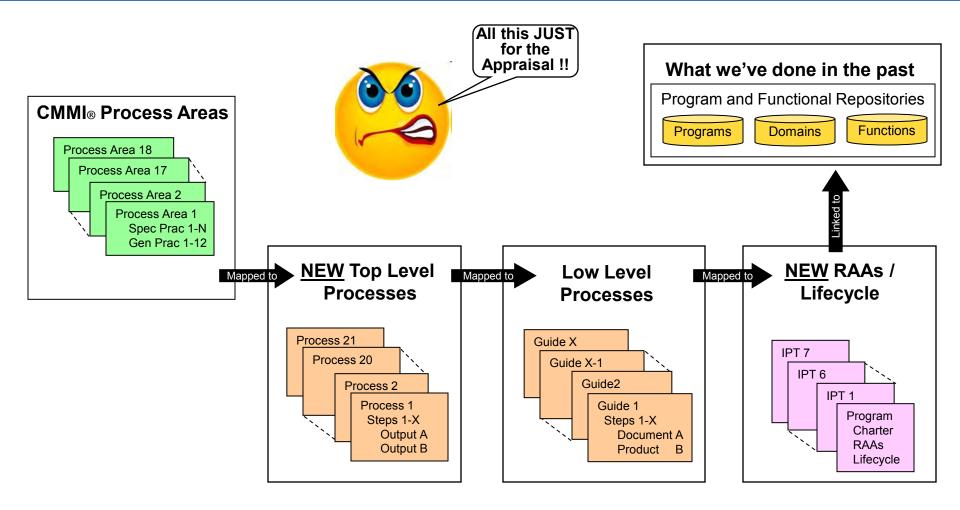
#### Succinctly Communicated Value of CMMI® Transition

- Business Case
  - Customers want it, competition using it
  - Proven best practices aligned with how we operate
  - Supports where we want to go
- Examples of Value Propositions
  - Shift from tactical to strategic thinking
  - Processes that are easier to locate
  - Better integration of activities
  - Faster access to data

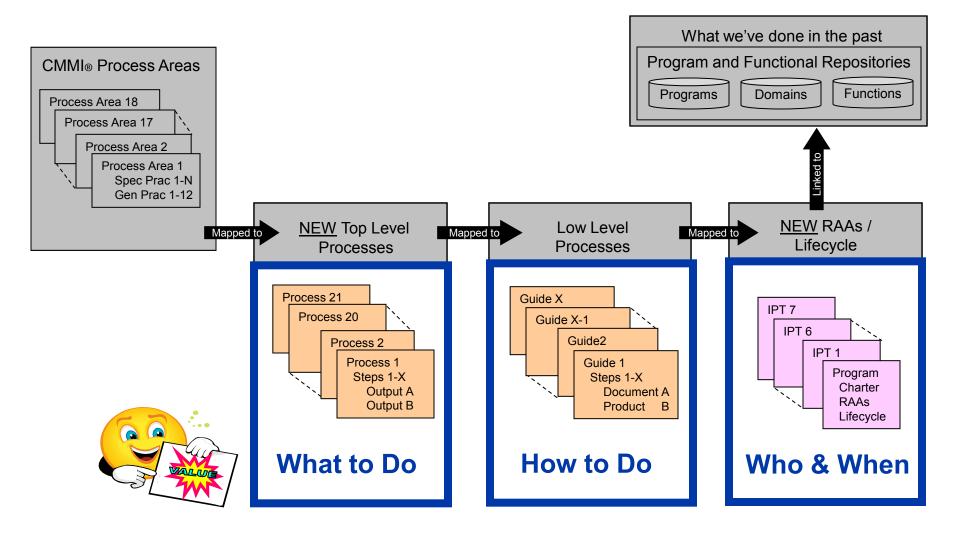


Related CMMI<sub>®</sub> to our Business and Operations

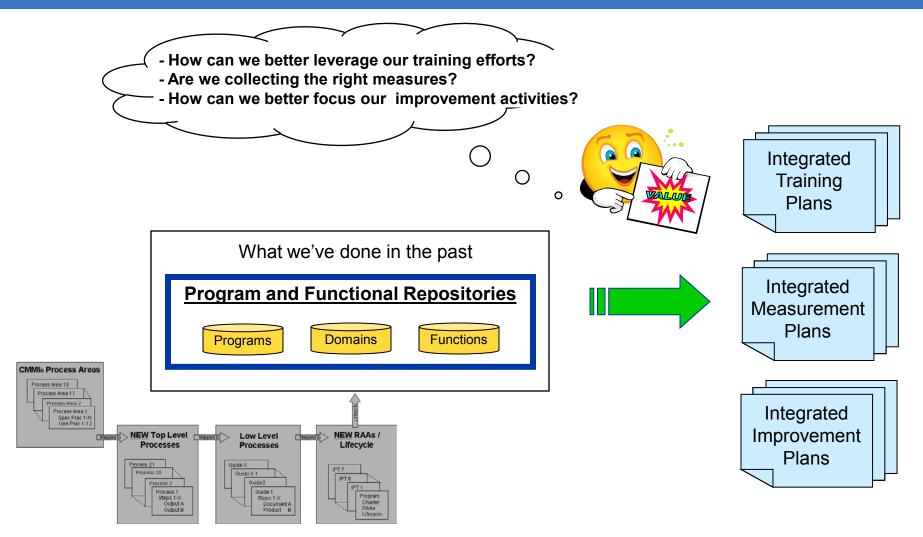
### Created Value Propositions from **Appraisal Preparation**



## **Appraisal Preparation Value Proposition 1:** Enable People to Understand How to do Their Jobs



## **Appraisal Preparation Value Proposition 2:** Use Data Collection to Integrate Critical Activities



### Numerous Value Propositions Stemmed from Multi-disciplined Problems

#### **Problem**

- Evaluation data not integrated
  - Remove redundancies
  - Ensure comprehensiveness





Now I know
where to focus our
resources



Leverage CMMI® PPQA & GP 2.9

| PROCESSES | INTEGRATED EVALUATION ACTIVITY |                       |             |           |               |          |                     |  |  |
|-----------|--------------------------------|-----------------------|-------------|-----------|---------------|----------|---------------------|--|--|
|           | Internal                       | Programs              | Functions   | Corporate | Customers     | AS9100   | CMMI                |  |  |
| Process A | Future                         | Progs 1 - 5<br>(2008) | Redundant   | 2008 Jan  | Cust 1 (2009) | 2007 Aug | Progs 1-3<br>(2009) |  |  |
| Process B | 2008 Feb                       | Prog 6 (2008)         | Future      |           | Cust 3 (2010) | Future   | Progs 3-4<br>(2009) |  |  |
| Process C | Future                         | Future                | Test (2009) | 2010 Oct  |               | 2009 Aug | Progs 2-4<br>(2009) |  |  |
| Process D | Future                         | Future                | Future      |           |               | Future   | Progs 2-4<br>(2009) |  |  |
| Process E | Redundant                      | Prog 8 (2008)         | Future      |           | Cust 2 (2010) | Future   | Progs 4-5<br>(2009) |  |  |

### Other Value Propositions Based on Simple, High Priority Use Cases

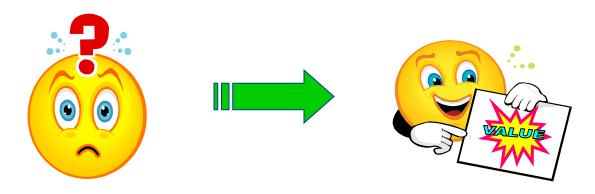


"Value Added !!"

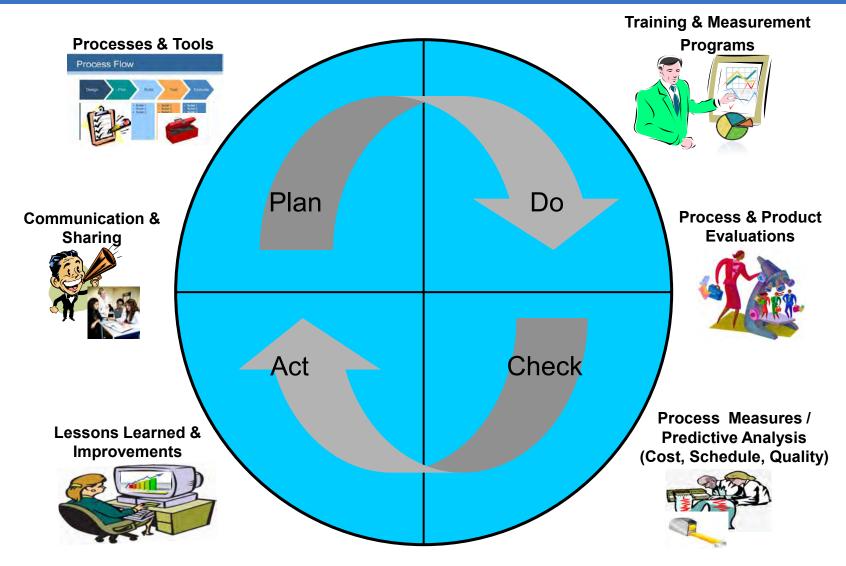
| Target Users               |                     |                |              |          | Use       |  |  |  |
|----------------------------|---------------------|----------------|--------------|----------|-----------|--|--|--|
| Prog, Func<br>Practitioner | Process<br>Councils | Process<br>SME | CMMI®<br>SME | Customer | Case<br># | Use Case Examples                        |  |  |
|                            | X                   | х              | x            |          | 1         | Are the right processes being deployed?  |  |  |
| Х                          | Х                   | X              | X            |          | 2         | How do I do my job?                      |  |  |
| х                          | X                   | X              | x            |          | 3         | Where can I find process related data?   |  |  |
|                            | х                   | х              | X            | х        | 4         | How effective is our evaluation program? |  |  |
|                            |                     |                | x            | Х        | 5         | What is our CMMI® approach?              |  |  |

### Framing Complex Value Propositions

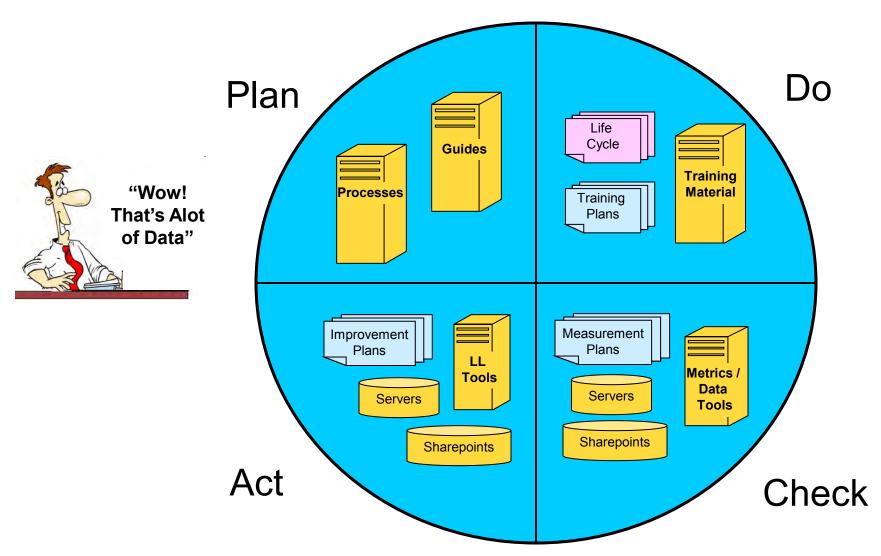
- Communication Challenge
  - CMMI® terminology
  - Broad scope of CMMI® effort
- Solution
  - 1. Translate CMMI® into how we operate
  - 2. Focus audience on the value proposition's scope
  - 3. Illustrate the value of the proposition



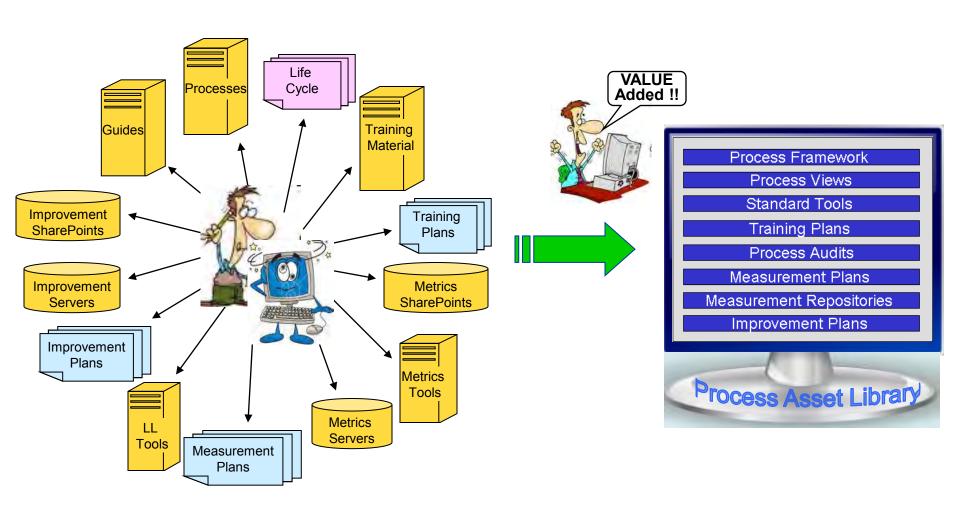
## Step 1 – Translate CMMI®: Process Management in Our Own Paradigm



### Step 2 – Focus the Audience: Large Quantity of Process Management Data



### Step 3 – Illustrate the Value: Turn Chaos into Organized Process Asset Library Views



### CMMI<sub>®</sub> Accelerated Our Capabilities in a Challenging Environment

- Integrated new processes
  - "What to", "How to" and "When to" execute
- Defined clear RAAs for operating teams
- Integrated training, measurement and improvement plans
- Provided single portal with global access to process data
- Implemented comprehensive data management approach
- Consolidated process and product evaluation information



#### All Validated by a CMMI<sub>®</sub> Level 3 Rating

#### Getting MORE Value from CMMI®

- Develop detailed CMMI<sub>®</sub> implementation strategy
- Involve all stakeholders



- Frame your value propositions as simply as possible
  - Translate CMMI<sub>®</sub> using operational scenarios
  - Focus discussions to the audience

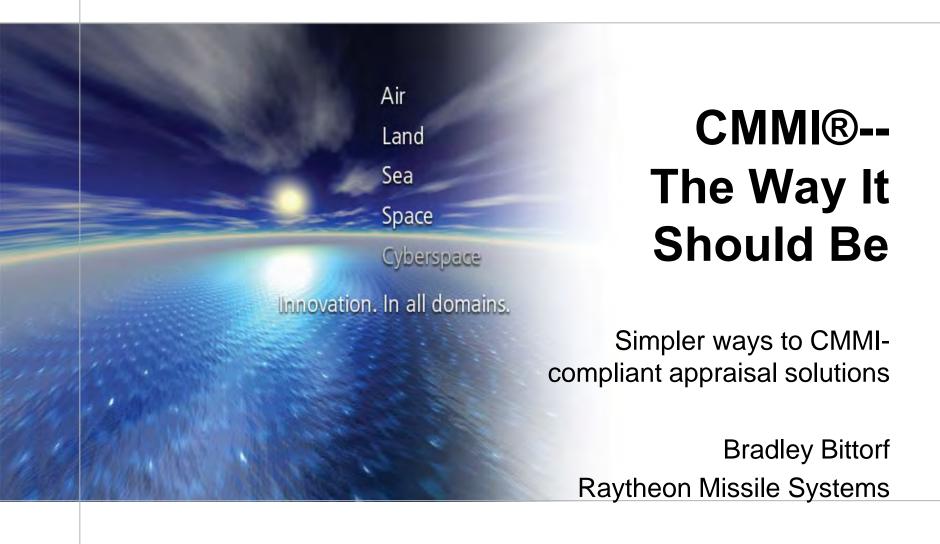
Use KISS: Keep It Simple Strategy!!

## Creating CMMI Value Propositions

## Questions?







## **Raytheon**Missile Systems

#### **Outline**

- Background: RMS Business Environment
- Ways to Overpay for a Successful Appraisal
  - Team Behaviors
  - Evidence Collection
  - Model Interpretation
- Questions
- Presenter Biography
- Backup



#### Raytheon Missile Systems' CMMI® Environment

- Raytheon is comprised of multiple businesses
  - One business is Raytheon Missile Systems (MS)
    - Characterized by high-(defense) volume, complex systems--"Rocket Science"
    - 12,000 people, >5000 engineers
  - Each Raytheon business manages its own CMMI® goals and appraisals
    - Knowledge sharing across business units
    - Prior Raytheon and RMS experience with SW-CMM, CMMI appraisals
  - Missile Systems has been appraised at Maturity Level 5 for CMMI for Development version 1.2 +IPPD











# Does your organization do this? [We did]



#### Evidence Collection

- Collect something to cover everything possible in the CMMI model?
- Address each and every sub-practice?
- Provide an example for each discipline in your organization?
- Collect evidence even when a demonstration or interview would more readily provide the evidence or affirmation?

#### Team Behavior

— Bow to the understandings and "expectations" of the appraisal team, even then they differ from, or are more restrictive than, the CMMI model?

#### Model Interpretation

- If a compound statement (such as GP3.2) is given in the CMMI, then provide evidence to address every element of that compound statement?
- If something is good, then providing more of it must be better?

### **Evidence Collection-1** "A Thread for All Disciplines"



We used to provide evidence threads for all disciplines. . .

- Decision Analysis and Resolution [DAR] examples shown
  - Software Thread [It must be good because we passed SW CMM with it!]
    - E.g., software DAR which board support package vendor to use
  - Hardware Thread [Yeah, more than just SW...let's add a HW example too!]
    - E.g., hardware DAR microprocessor choice
  - Systems Engineering Thread
    - [Let's combine SW and HW, and show some tradeoffs and "big picture" stuff!]
    - E.g., decision to do hardware or software filtering of images
  - "Glue-ware" and others [Hmm, we've got more stuff than SW, HW, & SysEng, what do we do with that?]
    - To explain how the choices are related to a program or how they connect
    - E.g. a make or buy decision, where to rent a test facility, etc.
- We probably don't need all these



Paul Schofield, in "A Man for All Seasons"

# **Evidence Collection – 2 Generic Practice "Bingo"**



- When generic practices [GP's] contain compound statements, we used to fill out the entire "bingo card"
  - GP "Tsar's" were appointed to ensure completeness of each GP's "bingo card"
    - We gathered examples to address as many permutations as possible
  - Examples
    - GP 2.3 Provide Resources
      - ☐ Schedule, Budget, People, Tools, Facilities, Resources
    - GP 3.2 Collect Improvement Information
      - □ Work Products, Measures, Measurement Results, Improvement Information
    - "It would be curious if . . . \*"
      - □ We didn't have anything in some rows or columns, but we don't need a full "Bingo Card"

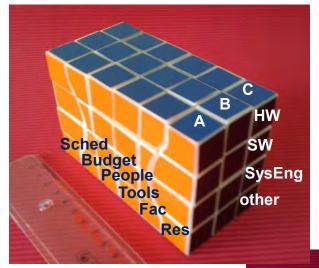
| PA         | Excal | JSOW | TTL | KA | NLOS |
|------------|-------|------|-----|----|------|
| CM GP3.2   | 1     | 1    | 1   |    | 1    |
| DAR GP3.2  |       | 1    | 1   |    | 1    |
| IPM SP1.5  | 1     |      | 1   | 1  | 1    |
| PI GP3.2   | 1     | 1    | 1   |    |      |
| PMC GP3.2  | 1     |      | 1   | 1  | 1    |
| PPQA GP3.2 |       | 1    |     |    |      |
| SAM GP3.2  | 1     |      | 1   |    | 1    |
| TS GP3.2   | 1     | 1    | 1   |    |      |
| VAL GP3.2  | 1     | 1    | 1   |    |      |
| VER GP3.2  | 1     | 1    | 1   |    |      |

<sup>\*</sup> Thanks to JFR Consulting for the use of this phrase

# **Evidence Collection – 3 Putting it All Together (yikes!)**



- Programs:
  - A
  - B
  - C
- Disciplines:
  - Hardware
  - Software
  - Systems Engineering
  - [Radar, Optics, Propulsion, Guidance...]
- GP2.3 elements:
  - Schedule
  - Budget
  - People
  - Tools
  - Facilities
  - Resources
- 3 \* 4 \* 6 = 72 pieces of evidence for each GP2.3!



## Evidence Collection – 4 More Fun with Generic Practices



- GP 2.2 Plan the Process
  - Establish and maintain the plan for performing <x> process
    - From page 620 of CMMI v1.2 for Development (glossary):
      - ["Establish and Maintain"] means more than a combination of its component terms; it includes documentation and usage. For example, "Establish and maintain an organizational policy for planning and performing the organizational process focus process" means that not only must a policy be formulated, but it must be documented and it must be used throughout the organization."
    - Some appraisal teams insist on finding original release of plan, plus revision to the plan
    - Alternatively, references to the plan; interview citations; other indications of use (for instance, peer review references to the plan or of the plan) also show maintenance
    - We may not need that "extra" piece of "maintain" evidence

# **Evidence Collection – 5 Shotgun Approach to Evidence**



- Hmm, I'm not sure how well this addresses the practice, so
- I'll provide multiple examples... in fact, I'll provide
- An example for each subpractice
- And if I'm not sure, then I'll provide multiple examples for each subpractice, because
- Each one should cover a little of the practice, and
- All together, they should be good, and
- The appraisal team will pick the ones they like best!

#### KA-BOOM!

(Somebody in this room once provided 13 examples for a single practice.)

# **Evidence Collection – 6 Collect Evidence We Don't Need**

- We can collect indirect, even though we expect we will get affirmations during interviews—let's be sure
- We plan to hold a demonstration, but let's collect screenshots of the demonstration content anyway... you never know

The evidence in this practice complies with the CMMI, but I would feel better. . .

- If we had a little more evidence in this area
  - Because most of our evidence has three or four and examples; this one only has two (that meet the model), or
- If we had more kinds of examples, or
- If we had the exact same kind of evidence from each program, or
  - If we had some of the programs re-work their evidence to match the format of the other programs, or
- If we could send a message to the program that they need to change because I don't like how they do it...even though I guess it <u>does</u> meet CMMI. But I don't like it. It's not what I'm used to seeing.

## Team Behavior – 1 True Statements from Team Members



- Let's write this up to change the program/organization behavior because even though it complies to the model, they need to change
- If one thread is good, then three should be better
- If we are uncertain about a particular process area, we can provide more examples
- If some evidence is good, then more is better
- What I expect to see is...

## Team Behavior – 2 What I Remember (or Am Used To) Must Be True



- Do everything that the Appraisal Team Lead wants unquestioningly
  - The Lead Appraiser has one (albeit important) vote on the team
- Do everything that each appraisal team member wants or expects
  - We have to do this—we've always done it this way in our other appraisals
  - The CMMI model is a wonderful resource consult it and the Method Definition Document [MDD] often
  - Maybe it doesn't say quite what you remember!

# Model Interpretation – 1 Ways to Focus on the Wrong Things



- We need to get our CMMI certificate, so. . .
  - We are going to drive changes to the program to support the quantitative processes we have selected
    - We will disrupt and perturb programs, but we will get our certificate, so that's OK--It doesn't matter whether the changes "stick"

#### Versus

- We need to help our organization improve, so. . .
  - Let's find what our programs and organizations need to focus on to meet their goals
  - Let's use our Six Sigma and CMMI model tools and best practices to support meeting those goals
    - Programs are satisfied and will agree to work with us again
    - Programs keep new behaviors that helped them address their risks



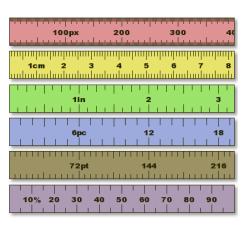
### Model Interpretation – 2 If Some is Good, All is Great



- Measurement and Analysis Process Area
  - MA can be used for all other process areas
  - Therefore, it should be used for all process areas, so
  - We are going to invent at least one metric that will measure something about each process area, and
  - We will mandate them to every project
  - Then we will improve everything!
    - (At least we will have a giant database of metrics, and we can figure out later what is most important)



- Let's think about which are the key factors that affect our performance to our goals, and prioritize measurement and analysis of those
  - A selective application of MA can make sense in many organizations
  - A metric of "DAR's planned versus DAR's executed" may not be the best way to expend resources



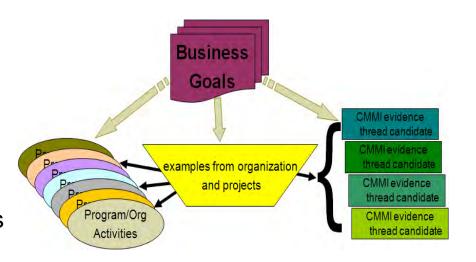


#### **Summary**

- Barriers to efficient, effective appraisals include
  - Misguided evidence collection
  - Certain team behaviors
  - CMMI model misinterpretations
- Ways to avoid these barriers
  - Live through these mistakes
    - And learn from them
  - Learn from somebody else's mistakes
  - Be brave about using common sense
  - Make the project and organizational goals your guiding principles
    - Don't think about things from the CMMI model/appraiser perspective first
    - The programs and organizations are your customer and priority

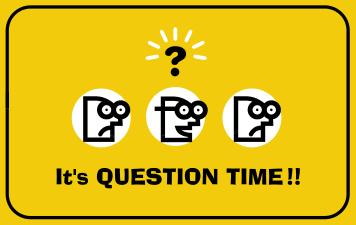
#### Cautions

- Sometimes you do need multiple pieces of evidence or threads
- Sometimes you should listen to your appraisal lead! ©









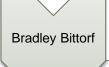








#### **Presenter Biography**



- Senior Principle Multi-disciplined Engineer, Raytheon Missile Systems, Tucson, AZ
- bjbittorf@raytheon.com
- +1.520.545.8035

Recent role

- Raytheon Missile Systems CMMI program manager
- Site appraisal manager
- Member of several CMMI appraisal teams

27 years engineering experience

- Functions: software, systems engineering, program management liaison, process improvements
- Industries: cell phones, industrial automation, missile systems
  - 3 patents high-reliability systems, redundancy, inter-process communication

Personal

- Long-time science fair judge
- Officer of the International Lilac Society
- Together with his wife Debbie, is a rated geocacher in the desert southwest
- Cat rescue



### BACKUP SLIDES

## **Raytheon**Missile Systems

#### **Abstract**

Abstract ID: 10779

■ Title: CMMI-The Way It Should Be

Abstract Text: CMMI-The Way It Should Be

- Why have three times as many artifacts as necessary when doing a CMMI appraisal? Why complicate the data collection and appraisal process by providing excess information and elaboration?
- Many organizations have evolved their approaches to CMMI compliance by building on prior work in the CMM and CMMI. Too often, these approaches focus on software as the lead thread, and supplement this with hardware, systems engineering, and disciplinary threads. Frequently these approaches represent an amalgamation of early successes and lessons learned that have been cobbled together to cover all the CMMI process areas. Sometimes they take the approach that if something from one discipline is good, it needs to be replicated in all disciplines. This approach can result in redundant or less-value-added effort to the appraised organization.
- Why not instead begin with a truly integrated approach that does not segregate or isolate disciplines? (After all, "Integration" is the "I" in "CMMI"!) The author proffers that using an integrated approach as a starting point for improving using the CMMI as framework saves cost and time, simplifies data collection and the actual appraisal process, and does not increase the risk to the organization.
- Examples from our organization's recent CMMI Level 5 appraisal will be cited to show the differences between the Raytheon Missile Systems approach and the approach we have seen presented by many others. In particular, aspects of data collection, data and thread coverage, and ways to meet the requirements of the CMMI and the Method Description Document (MDD) will be addressed. The presentation will also discuss training and "big picture" views of this approach to CMMI and appraisals.



#### **CMMI®** for Small Business

NDIA CMMI® Working Group NDIA Systems Engineering Division

**CMMI Technology Conference** 

**November 17, 2010** 

#### **Small Business in the Defense Industry**



## The defense industry is critically dependent on small business for the technology and rapid innovation needed for future defense business.

- "...In one of the few studies of its kind, the Pentagon's industrial policy office in 2005 identified the critical, innovative technologies which are needed for 21<sup>st</sup> century wars and found that 35 to 45 percent of the companies supplying those key technologies had fewer than 100 employees."
- NDIA National Defense Magazine (June 2010),

http://www.nationaldefensemagazine.org/archive/2010/June/Pages/PentagonNeedsInnovativeMid-TierContractors.aspx

## However, small businesses can be challenged to compete and thrive in the defense market.

"... Only the largest firms have access to the resources and expertise to bid on the most complex programs, and it is difficult for all but the largest size to survive losing them. As a result, competition is reduced at the front end of programs, and all but eliminated in the sustainment phase.... Small businesses are largely locked out of the process or accorded contracts only on the goodwill of one of the larger firms.... The end result of this process is the gradual erosion of competition and innovation in the defense industrial base."

-House Armed Services Committee Panel on Defense Acquisition Reform, Findings and Recommendations (March 2010) http://armedservices.house.gov/pdfs/DARFINALREPORT/DARFINALREPORT032310.pdf

## Is CMMI for Small Business?



The NDIA CMMI Working Group was tasked to investigate common questions on the applicability of CMMI to small business

- Is CMMI appropriate for small businesses?
- Is CMMI a barrier to competition in the defense market?
- What data substantiates the adoption of CMMI by small business?
- What challenges do small businesses face for adoption?
- How can acquirers use CMMI to manage their acquisition risks with small suppliers?



## What is a Small Business?



#### There is no single definition of what constitutes a small business.

# The SBA characterizes small businesses in terms of size and revenue, by domain

- Size standards defined by North American Industrial Classification System (NAICS)
- Typically ~250 employees, < \$25M in revenue</li>

#### SEI research characterizes a small setting as:

- Small business < 100 people
- Small organization within a large organization, < 50 people
- Small project < 20 people

#### For this study, we did not set thresholds, but focused on employee size across a wide range of data partitions

- As small as a few people
- As large as several thousand people
- 'Small' may be in the eye of the beholder



NDIA Small Business Division http://www.ndia.org/Divisions/Divisions/SmallBusiness/ Pages/default.aspx

U.S. Small Business Administration size standards: <a href="http://www.sba.gov/contractingopportunities/officials/size/index.html">http://www.sba.gov/contractingopportunities/officials/size/index.html</a>

## **Prior Studies and Research**



# Many prior initiatives have investigated CMMI for small business. Example resources include:

#### **CMMI in Small Settings Toolkit Repository**

Suzanne Garcia (SEI), Sandra Cepeda (AMRDEC SED/CSSA), Gene Miluk (SEI), Mary Jo Staley (AMRDEC SEC/CSC) http://seir.sei.cmu.edu/toolkit/index.html

#### Improving Processes in Small Settings (IPSS)

**International Process Research Consortium (IPRC)** 

"Proceedings of the 1st International Researcher's Workshop on Process Improvement in Small Settings"

http://www.sei.cmu.edu/publications/documents/06.reports/06sr001.html

"An exploratory study investigating the organizational and technical impacts of applying disciplined system development processes (CMMI<sup>TM</sup>) in small to medium sized enterprises." Miluk, Gene. Ph.D. dissertation, Pepperdine University, 2006. http://gradworks.umi.com/32/24/3224161.html





The CMMI WG conducted interviews and discussions with several of these researchers and subject matter experts.

# CMMI for Small Business – Data Collection and Analysis

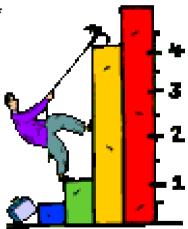


There are plenty of anecdotes, speculations, and opinions on the applicability of CMMI for small business – what does the data tell us?

• SEI CMMI® Process Maturity Profile\* http://www.sei.cmu.edu/cmmi/casestudies/profiles/cmmi.cfm

 SEI Published SCAMPI<sup>SM</sup> Appraisal Results (PARS)\* <a href="http://sas.sei.cmu.edu/pars/">http://sas.sei.cmu.edu/pars/</a>

- Organizational change research
   Dr. Leigh Riley, <a href="mailto:leigh@acmeprocessgroup.com">leigh@acmeprocessgroup.com</a>
- 1st International Research Workshop for Process Improvement in Small Settings <a href="http://www.sei.cmu.edu/library/abstracts/reports/06sr001.cfm">http://www.sei.cmu.edu/library/abstracts/reports/06sr001.cfm</a>
- Surveys, questionnaires, ...



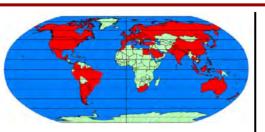
\*Caveats: Most CMMI data is reported and collected from appraisals based on size of the organizational unit – which may or may not be directly reflective of the size of the company overall.

Other companies may also be using CMMI beyond just those conducting and reporting SCAMPI-A appraisals.

## **CMMI** Adoption



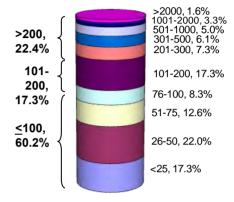
CMMI appraisals are conducted worldwide...



|                                    | ı |
|------------------------------------|---|
| Commercial In-House                |   |
| Contractor for Military/Government |   |
| Military/Government Agency         |   |
|                                    |   |

|   | US   | SA     | Non-USA |        |  |  |  |  |  |  |
|---|------|--------|---------|--------|--|--|--|--|--|--|
|   | Qty  | %      | Qty     | %      |  |  |  |  |  |  |
|   | 425  | 35.2%  | 3354    | 91.8%  |  |  |  |  |  |  |
| : | 651  | 54.0%  | 223     | 6.1%   |  |  |  |  |  |  |
|   | 130  | 10.8%  | 76      | 2.1%   |  |  |  |  |  |  |
|   | 1206 | 100.0% | 3653    | 100.0% |  |  |  |  |  |  |
|   | 25%  |        | 75%     |        |  |  |  |  |  |  |

...in small and large organizations and projects



Organization Size (Employees) (4863 organizations reporting)

#### ...in a wide range of businesses

#### **Services (72.1%)**

- Business Services
- Engineering and Management Services
- · Health Services
- Other Services

Based on primary Standard Industrial Classification (SIC) codes reported in CMMI-based appraisals.

#### **Manufacturing** (15.7%)

- Electronic and Electric Equipt
- Transportation Equipment
- Instruments & Related Products
- · Industrial Machinery
- · Other Mfg Industries

#### Other (12.2%)

- Finance, Insurance, Real Estate
- Public Administration/Defense
- Transportation, Communication, Utilities

#### ...at all levels of process maturity

|                              | Commercial<br>In-House | Contractor<br>for Military/<br>Government | Military/<br>Government<br>Agency |
|------------------------------|------------------------|---|-----------------------------------|
| No Rating Given              | 5.3%                   | 8.0%                                      | 22.3%                             |
| Initial (ML1)                | 0.6%                   | 1.4%                                      | 1.0%                              |
| Managed (ML2)                | 25.8%                  | 31.5%                                     | 45.6%                             |
| Defined (ML3)                | 58.1%                  | 49.3%                                     | 26.7%                             |
| Quantitatively Managed (ML4) | 2.9%                   | 1.0%                                      | 1.5%                              |
| Optimizing (ML5)             | 7.2%                   | 8.9%                                      | 2.9%                              |
|                              | (3779 orgs)            | (874 orgs)                                | (206 orgs)                        |

Source: SEI Process Maturity Profile, Sept 2010.

http://www.sei.cmu.edu/cmmi/casestudies/profiles/cmmi.cfm

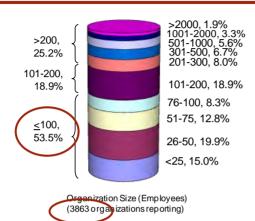
CMMI for Executives

## **Adoption Trends in Small Business**

Comparison: SEI Process Maturity Profile, Sep 2009 vs. Sep 2010

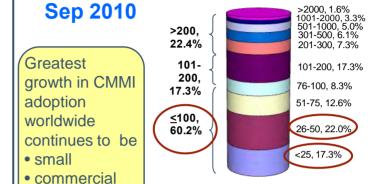


**Sep 2009** 



|                              |             | Contractor    | Military/  |
|------------------------------|-------------|---------------|------------|
|                              | Commercial  | for Military/ | Government |
| _                            | In-House    | Government    | Agency     |
| No Rating Given              | 5.7%        | 8.5%          | 22.7%      |
| Initial (ML1)                | 0.8%        | 1.6%          | 1.7%       |
| Managed (ML2)                | 28.0%       | 31.7%         | 44.3%      |
| Defined (ML3)                | 53.6%       | 46.7%         | 26.7%      |
| Quantitatively Managed (ML4) | 3.1%        | 1.4%          | 1.1%       |
| Optimizing (ML5)             | 8.7%        | 10.1%         | 3.4%       |
|                              | (2920 orgs) | (769 orgs)    | (176 orgs) |

|                                    | US    | SA     | Non-USA |               |  |
|------------------------------------|-------|--------|---------|---------------|--|
|                                    | Qty   | %      | Qty     | %             |  |
| Commercial In-House                | 354   | 33.6%  | 2566    | 91.3%         |  |
| Contractor for Military/Government | 586   | 55.7%  | 183     | 6.5%          |  |
| Military/Government Agency         | 113   | 10.7%  | 63      | 2.2%          |  |
|                                    | 1053  | 100.0% | 2812    | 100.0%        |  |
| •                                  | 27.2% | (      | 72.8%   | $\overline{}$ |  |



overseas

|                              |             | Contractor    | Military/  |
|------------------------------|-------------|---------------|------------|
|                              | Commercial  | for Military/ | Government |
|                              | In-House    | Government    | Agency     |
| No Rating Given              | 5.3%        | 8.0%          | 22.3%      |
| Initial (ML1)                | 0.6%        | 1.4%          | 1.0%       |
| Managed (ML2)                | 25.8%       | 31.5%         | 45.6%      |
| Defined (ML3)                | 58.1%       | 49.3%         | 26.7%      |
| Quantitatively Managed (ML4) | 2.9%        | 1.0%          | 1.5%       |
| Optimizing (ML5)             | 7.2%        | 8.9%          | 2.9%       |
|                              | (3779 orgs) | (874 orgs)    | (206 orgs) |

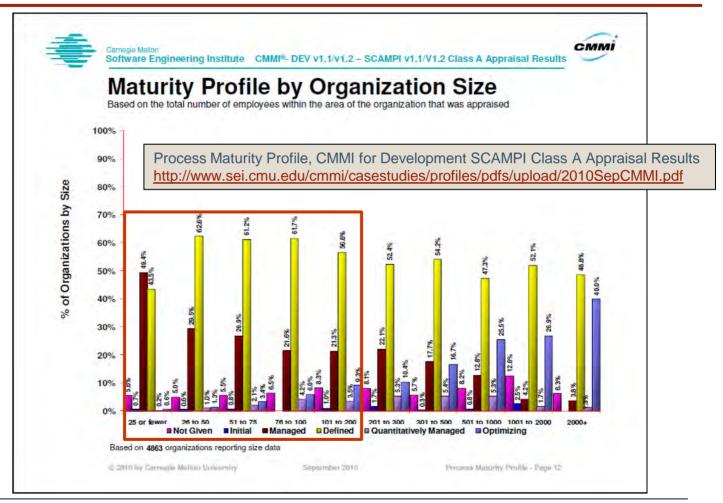
Organization Size (Employees)

(4863 organizations reporting)

| _                                  | US    | SA     | Non-USA |        |  |
|------------------------------------|-------|--------|---------|--------|--|
|                                    | Qty   | %      | Qty     | %      |  |
| Commercial In-House                | 425   | 35.2%  | 3354    | 91.8%  |  |
| Contractor for Military/Government | 651   | 54.0%  | 223     | 6.1%   |  |
| Military/Government Agency         | 130   | 10.8%  | 76      | 2.1%   |  |
|                                    | 1206  | 100.0% | 3653    | 100.0% |  |
|                                    | 24.8% |        | 75.2%   |        |  |

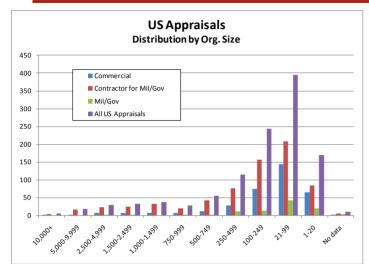
# What's the CMMI maturity profile for small businesses?





# **Are Small U.S. Businesses Using CMMI?**





- U.S. organizations of all sizes are conducting SCAMPI-A appraisals, including very small organizations.
- Large % of U.S. appraisals conducted in all domains are by small organizations (<100 people): commercial (59.5%), govt. contractors (42.3%), govt (65.6%)
- CMMI use overseas is overwhelmingly commercial.
   Within U.S., predominantly govt contractors (60.6%) but with significant usage in commercial industry (30.9%).

Based on data from published SCAMPI appraisal results for <u>organizations</u> – which could be part of a large company.

|        |                   |         |             | 2,500- | 1,500- | 1,000- |         |         |         |         |       |       |
|--------|-------------------|---------|-------------|--------|--------|--------|---------|---------|---------|---------|-------|-------|
|        | US                | 10,000+ | 5,000-9,999 | 4,999  | 2,499  | 1,499  | 750-999 | 500-749 | 250-499 | 100-249 | 21-99 | 1-20  |
|        | Commercial        | 0.3%    | 0.3%        | 1.7%   | 2.0%   | 1.7%   | 1.7%    | 3.1%    | 8.0%    | 21.1%   | 41.0% | 18.5% |
| Contra | actor for Mil/Gov | 0.6%    | 2.5%        | 3.3%   | 3.5%   | 4.6%   | 2.9%    | 6.1%    | 11.0%   | 22.6%   | 30.1% | 12.2% |
|        | Mil/Gov           | 0.0%    | 0.0%        | 1.0%   | 1.0%   | 0.0%   | 1.0%    | 2.1%    | 11.5%   | 14.6%   | 44.8% | 20.8% |

|            |              |         |             | 2,500- | 1,500- | 1,000- |         |         |         |         |       |       |         |       |     |
|------------|--------------|---------|-------------|--------|--------|--------|---------|---------|---------|---------|-------|-------|---------|-------|-----|
|            | US           | 10,000+ | 5,000-9,999 | 4,999  | 2,499  | 1,499  | 750-999 | 500-749 | 250-499 | 100-249 | 21-99 | 1-20  | No data | Total |     |
|            | Commercial   | 1       | 1           | 6      | 7      | 6      | 6       | 11      | 28      | 74      | 144   | 65    | 2       | 351   | 31% |
| Contractor | for Mil/Gov  | 4       | 17          | 23     | 24     | 32     | 20      | 42      | 76      | 156     | 208   | 84    | 5       | 691   | 61% |
|            | MII/Gov      | 0       | 0           | 1      | 1      | 0      | 1       | 2       | 11      | 14      | 43    | 20    | 3       | 96    | 8%  |
|            |              |         |             |        |        |        |         |         |         |         |       |       |         |       |     |
| All US     | S Appraisals | 5       | 18          | 30     | 32     | 38     | 27      | 55      | 115     | 244     | 395   | 169   | 10      | 1138  |     |
|            | %            | 0.4%    | 1.6%        | 2.6%   | 2.8%   | 3.3%   | 2.4%    | 4.8%    | 10.1%   | 21.4%   | 34.7% | 14.9% | 0.9%    |       |     |

|                                    | Non-US | U.S. | Grand Total |
|------------------------------------|--------|------|-------------|
| Commercial/In-house                | 3352   | 352  | 3704        |
| Contractor for Military/Government | 206    | 690  | 896         |
| Military/Government Agency         | 73     | 96   | 169         |
| Grand Total                        | 3631   | 1138 | 4769        |

|                                    | Non-US | U.S.   | Grand Total |
|------------------------------------|--------|--------|-------------|
| Commercial/In-house                | 92.3%  | 30.9%  | 77.7%       |
| Contractor for Military/Government | 5.7%   | 60.6%  | 18.8%       |
| Military/Government Agency         | 2.0%   | 8.4%   | 3.5%        |
| Grand Total                        | 100.0% | 100.0% | 100.0%      |

# Are small businesses using CMMI in the U.S. defense contracting market?



|            | US            | 10,000+ | 5,000-9,999 | 2,500-<br>4,999 | 1,500-<br>2,499 | 1,000-<br>1,499 | 750-999 | 500-749 | 250-499 | 100-249 | 21-99 | 1-20  | No data | Total |     |
|------------|---------------|---------|-------------|-----------------|-----------------|-----------------|---------|---------|---------|---------|-------|-------|---------|-------|-----|
|            | Commercial    | 1       | 1           | 6               | 7               | 6               | 6       | 11      | 28      | 74      | 144   | 65    | 2       | 351   | 31% |
| Contractor | r for Mil/Gov | 4       | 17          | 23              | 24              | 32              | 20      | 42      | 76      | 156     | 208   | 84    | 5       | 691   | 61% |
|            | Mil/Gov       | 0       | 0           | 1               | 1               | 0               | 1       | 2       | 11      | 14      | 43    | 20    | 3       | 96    | 8%  |
|            |               |         |             |                 |                 |                 |         |         |         |         |       |       |         |       |     |
| All US     | S Appraisals  | 5       | 18          | 30              | 32              | 38              | 27      | 55      | 115     | 244     | 395   | 169   | 10      | 1138  |     |
|            | %             | 0.4%    | 1.6%        | 2.6%            | 2.8%            | 3.3%            | 2.4%    | 4.8%    | 10.1%   | 21.4%   | 34.7% | 14.9% | 0.9%    |       |     |

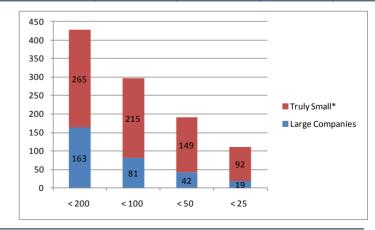
Data from SCAMPI appraisal results is for organizational units (OUs) – which could be part of a larger company. Overall company size is not available from SCAMPI results filed with SEI.

From the data set of 691 appraisals by U.S. government contractors:

- 428 were by OUs < 200 people
- Known large companies were removed from this data set
- \*Best judgment is 265 appraisals (62%) were conducted by truly small companies < 200 people</li>
- This 265 appraisals reflects 38% of the complete data set (all sizes, 691 appraisals)

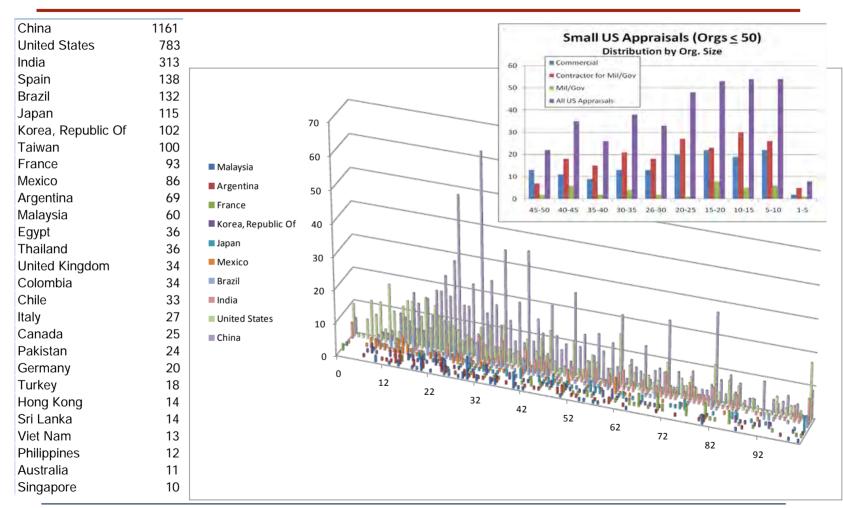
Even though these reflect estimates, they substantiate significant usage of CMMI by small companies in the U.S. defense market.

| Size<br>(Employees) | Total<br>Appraisals | Large<br>Companies | Truly<br>Small* | % Truly<br>Small |
|---------------------|---------------------|--------------------|-----------------|------------------|
| < 200               | 428                 | 163                | 265             | 62%              |
| < 100               | 296                 | 81                 | 215             | 73%              |
| < 50                | 191                 | 42                 | 149             | 78%              |
| < 25                | 111                 | 19                 | 92              | 83%              |



# What countries conduct the most small appraisals? Number of appraisals reported with organization size < 100



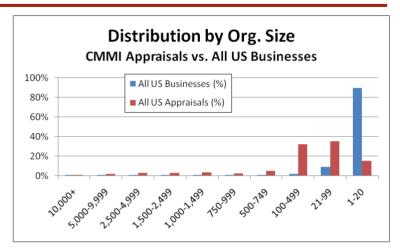


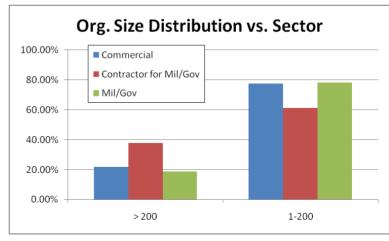
## **Other Observations**



Under-representation of small organizations (CMMI data) relative to small US businesses overall (Census data) *may* represent a marketing opportunity

There is more proportional interest among small commercial orgs. than other orgs.  $(p = 0.000 \text{ on a } \chi^2 \text{ test})$ 

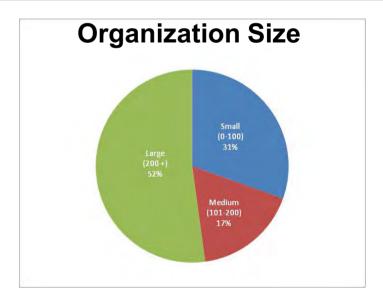




- A Mixed Method Analysis to Refine an Organizational Change Model for Technology Organizations, Doctoral Dissertation, University of Phoenix, Dr. Leigh Riley, 2010
- Survey and analysis of organizational change factors ensuring successful implementation of CMMI®-Dev by IT organizations
- Further analyses will be published next year as an addendum to the Protean Model<sup>®</sup>

### **Participant Demographics**

| Employment Level    | Survey Participants |            |
|---------------------|---------------------|------------|
|                     | Number              | Percentage |
| Executive           | 5                   | 7%         |
| Management          | 25                  | 34%        |
| Senior Technical    | 7                   | 9%         |
| Technical           | 1                   | 1%         |
| Process Improvement | 33                  | 45%        |
| Other               | 3                   | 4%         |
| Total               | 75                  | 100%       |



### Ranking of Organizational Change Factors by Size of the Organization

| Rank | Small  | Medium  | Large   |
|------|--|---|---|
| 1    | Senior Leadership Support                    | Senior Leadership Support                     | Communication                                 |
| 2    | Operational Leadership                       | Communication                                 | Senior Leadership Support                     |
| 3    | Communication                                | Operational Leadership                        | Measuring of Progress                         |
| 4    | Training the Leadership                      | Training the Employees                        | Training the Employees                        |
| 5    | Training the Employees                       | Measuring of Progress                         | Aligning the Initiative with Strategic Goals  |
| 6    | Measuring of Progress                        | Aligning the Initiative with Strategic Goals  | Articulating the Benefits                     |
| 7    | Managing Initiative as a Project             | Incremental Improvements                      | Managing Initiative as a Project              |
| 8    | Aligning the Initiative with Strategic Goals | Providing SupportMechanisms                   | Operational Leadership                        |
| 9    | Providing Support Mechanisms                 | Managing Initiative as a Project              | Providing Support Mechanisms                  |
| 10   | Articulating the Benefits                    | Training the Leadership                       | Training the Leadership                       |
| 11   | Incremental Improvements                     | Articulating the Benefits                     | Incremental Improvements                      |
| 12   | Involving Employees                          | Involving Employees                           | Involving Employees                           |
| 13   | Changing the Performance Management System   | Changing the Performance Management<br>System | Changing the Performance Management<br>System |

Factors for effective organizational change are similar across different sizes of businesses, but initiatives may have shifting priorities (e.g., tactical to strategic)

# **Improving Processes in Small Settings**



- "Proceedings of the 1st International Researcher's Workshop on Process Improvement in Small Settings" http://www.sei.cmu.edu/publications/documents/06.report s/06sr001.html
- "Improving Processes in Small Settings (IPSS): A White Paper" International Process Research Consortium (IPRC). Software Engineering Institute
  - ➤ Phase 1: Qualitative study
  - Phase 2: Quantitative research

#### Barriers to entry:

- > Lacking core competencies, basic practices
- > PI costs within operating budget
- Clear roles/responsibilities, flat hierarchy
- > Infrastructure
- Staff culture

Reference: Applicability of CMMI to Small and Medium Enterprises Dr. Rick Hefner and Maggie Glover. SC SPIN, April 2010.

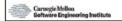
#### Phase-1 Results

#### CMMI SME implementation issues:

- Size CMMI is considered too large by SMEs
- Linkage to SME problems is not immediately evident
- Lack of SME implementation knowledge, infrastructure and resources to translate process framework into value added operational processes

#### CMMI Alternative Approaches:

- CMMI-SME Front-end: Provide direct link of SME development problems to the appropriate practices in the model
- CMMI-SME Back-end: Link of model components to off the shelf "whole" product solutions appropriate for SME implementation
- The optimum packaging for the CMMI-SME would provide "line of sight" connectivity from SME problem to model components to implementation solutions



ORTHROP GRUMMAN

#### Pain Associated with Improving Existing **Products or Developing New Products**

|  | Average  | Standard  |
|--|----------|-----------|
|  | Response | Deviation |
| Above Average "Pain"                                   |          |           |
| The time it takes to get to market / recognize revenue | 7.2      | 2.0       |
| Trying to accelerate corporate grow th                 | 6.7      | 2.2       |
| Average "Pain"   |          |           |
| Development of new products or features                | 6.0      | 1.9       |
| Capitalization / funding new product efforts           | 6.0      | 2.8       |
| Compliance issues with partners                        | 5.6      | 1.9       |
| Quality assurance / quality control issues             | 5.4      | 2.1       |
| Incorporating increasing systems or softw are into     |          |           |
| new or improved products                               | 5.3      | 2.4       |
| Historical New Product Failures                        | 5.2      | 2.2       |
| Below Average "Pain"                                   |          |           |
| ISO or QS 9000 Compliance                              | 4.6      | 2.3       |

Software Engineering Institute

http://www.uces.csulb.edu/SPIN/media/ppslide/Rick%2007CMMI%20Small%20Settings%20Part%20I.ppt

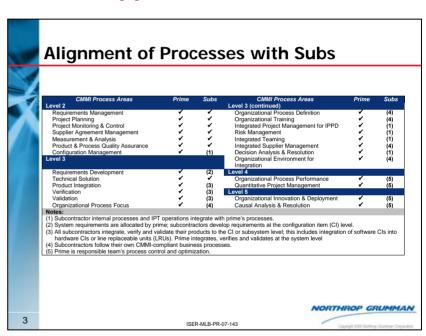
# **Supporting Small Suppliers**



Acquirers (such as prime contractors) often use CMMI practices to select, manage, and support their small suppliers.

# Typical uses of CMMI within CMMI WG member companies:

- CMMI maturity level requirements rarely specified to subs unless levied by external customer
- Use CMMI practices in key areas to evaluate supplier risks
- Checklists or tools used for supplier selection
- May require suppliers to follow prime contractor's processes
- Provide direct support to suppliers
  - training, mentoring, tools, etc.



<u>Reference</u>: "High Maturity System/Software Cost Estimation", Richard L. W. Welch, PhD., Northrop Grumman Integrated Systems CMMI Technology Conference, November 2007.

http://www.dtic.mil/ndia/2007cmmi/Wednesday/4pmWelch.pdf

# Resources – Publications, briefings, social networks



Many small businesses and their consultants share their CMMI experience in publications and conference briefings.

Over 40,000 Google hits on "CMMI" "small business"

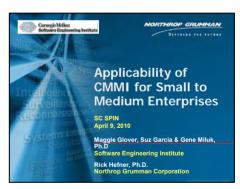
#### Other good resources:

- SEI tech reports, guidance, adoption info, case studies, ... http://www.sei.cmu.edu/cmmi
- NDIA CMMI Conference briefings http://www.dtic.mil/ndia/
- SEI SEPG Conference briefings <a href="http://www.sei.cmu.edu/sepg/">http://www.sei.cmu.edu/sepg/</a>
- CrossTalk articles <a href="http://stsc.hill.af.mil/crosstalk/">http://stsc.hill.af.mil/crosstalk/</a>
- SPIN meetings
- Newsgroups, social networks (Yahoo!, Linked In, Facebook, ...)
- RSS feeds
- Webinars "Process Improvement at the Edges"
   http://www.sei.cmu.edu/library/abstracts/webinars/18dec2008.cfm

There is no shortage of good people willing to help – just ask!



http://seispin.wikispaces.com/file/view/ipss.ppt



http://www.uces.csulb.edu/SPIN/media/ppslide/Rick%2007CMMI%20Small%20Settings%20Part%20I.ppt

# Resources – Guidance for Effective CMMI Adoption



#### **SEI Resources:**

- CMMI in Small Settings Toolkit Repository http://seir.sei.cmu.edu/toolkit/index.html
- Reports & Technical Notes Interpretative Guidance, ... http://www.sei.cmu.edu/cmmi/casestudies/reports/
- CMMI Roadmaps goal-driven process area guidance <a href="http://www.sei.cmu.edu/library/abstracts/reports/08tn010.cfm">http://www.sei.cmu.edu/library/abstracts/reports/08tn010.cfm</a>
- Using the Software CMM in Small Organizations
  - Mark Paulk papers: SW-CMM, but still good guidance (if you can find it)

#### **NDIA Resources:**

- The Effective Use of CMMI NDIA position paper
   http://www.ndia.org/Divisions/Divisions/SystemsEngineering/Pages/CMMI\_Working\_Group.aspx
- The Economics of CMMI CMMI WG white paper
   <a href="http://www.ndia.org/Divisions/Divisions/SystemsEngineering/Documents/Committees/CMMI%20Working%20Group/The\_Economics\_of\_CMMI.pdf">http://www.ndia.org/Divisions/Divisions/SystemsEngineering/Documents/Committees/CMMI%20Working%20Group/The\_Economics\_of\_CMMI.pdf</a>

#### **Consultant Resources ... and many others**





# **Summary and Recommendations**



# Perceptions that CMMI is too burdensome for small businesses is not supported by data on CMMI adoption

- Greatest growth areas: small, commercial, overseas
- No evidence that CMMI is a barrier to competition

#### Small businesses face many of the same obstacles as large companies

- Sponsorship, commitment, resources, alignment with business objectives, ...
- Tailored processes and priorities adapted to meet the needs of the business
- Small businesses often have fewer resources to address these challenges
- But they also have advantages: agility, innovation, simplicity, institutionalization

#### Follow proven guidance for using CMMI effectively

- Focus on business value The Economics of CMMI®
- Set performance goals, measure progress against them, use CMMI to improve
- Learn from others take advantage of the many resources available to help

# For More Information....



### **NDIA CMMI Working Group**

http://www.ndia.org/Divisions/Divisions/SystemsEngineering/Pages/CMMI Working Group.aspx

Jim Armstrong
Stevens Institute

Geoff Draper
Harris Corporation

Wendell Mullison General Dynamics, Land Systems Steve Austin

Lockheed Martin

Jeffrey L. Dutton
Jacobs Technology

**Rick Welch** *Northrop Grumman* 

**Dan Blazer** 

SAIC

Nancy Fleischer Raytheon Company Michael Campo
Raytheon Company

Kathy Smith

Hewlett Packard EDS

#### With special appreciation to key contributors and subject matter experts:

Leigh Riley, Acme Process Group Mike Phillips, Software Engineering Institute Gene Miluk, Software Engineering Institute Bill Van Dalsem, NASA Hal Wilson, Northrop Grumman Rick Hefner, Northrop Grumman Lynn Penn, Lockheed Martin CMMI Steering Group



# The Tailoring Dilemma

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Boeing Military Aircraft
Mobility - Philadelphia
November 17, 2010

# The Tailoring Dilemma

- •CMMI tries to balance flexibility with consistency in adapting an organization's set of standard practices to a project. Decisions are at the project level per guidelines.
- •The typical corporate approach stresses commonality and high level approvals of changes.
- •The Dilemma: How to balance commonality and corporate control with project flexibility and low-level decisions
- This is a "Money" process -
  - Do it right, and you maximize value
  - Do it wrong, and you have waste and inefficiency

# The Tailoring Dilemma

- •The CMMI approach to Tailoring is that a standard set of processes must be tailored (adjusted by additions, elaborations, deletions, or changes) to fit the needs of a project
- •The Corporate approach for most large companies (and many others) is to have a standard set of processes that cannot be changed or deleted except via a rigorous approval and documentation process
- •CMMI favors management of processes close to where the work is done
- •The Corporate approach favors moving more of the process management to a high level, central area
- These differences need to be reconciled for both sets of objectives to be met

# **Recognition of Certain Factors**

- Solving the dilemma requires recognition of a number of factors, and then developing solutions that satisfy (or at least consider) each
  - Not all processes do the same kind of thing
    - Some tell how to do work, such as the typical engineering process
    - Some control business requirements, such as use of specific clauses in subcontracts
    - Different departments/ functions may have different needs
  - May require different treatment of additions/ elaborations, changes, and deletions, and different disciplines
  - Even with good, approved tailoring guidelines, may need to divide tailoring decisions between Project Process Group and corporate management

# Authority based on trust and guidelines

- CMMI provides for tailoring based on guidelines approved by management steering group
- Corporations delegate authority in constrained ways, based in large part on trusting those given the authority
  - Experience and track record of individuals
  - Processes to control individuals/ incentives to follow direction
  - Tiers of authority, size of projects, dollar value, risk
  - Number of processes in an area/ number of tailoring decisions
  - Domain & department differences e.g., software vs. hardware, engineering vs. finance

# **Project Variation a factor**

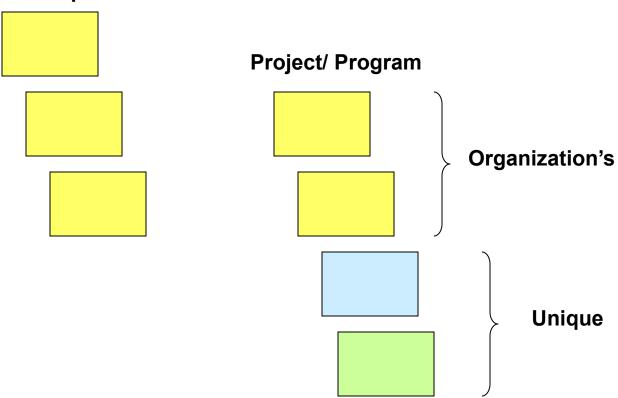
- Commercial vs. Defense and Space projects
  - Commercial often to internal standards, so less need to recognize project differences
  - Defense and Space often have more project and customer variation, more need to tailor to recognize differences
    - Different products have different risk levels (manned space vs. legacy aircraft designs or ground equipment)
    - Spiral vs. waterfall development
    - "Clean sheet of paper" vs. legacy projects
    - Team stability, experience together can vary

## **Cultural and Individual Differences**

- Many companies now comprised of parts with different backgrounds
  - Some have culture of micro-managing, little trust
  - Some delegate considerable authority, great trust
  - Some like process detail, some do not
  - Some are highly disciplined, some are not
  - Some have lots of work; some do not, and protect their "rice bowls"
  - Some have experienced workforce, some have beginners
- Executives approving corporate approach to tailoring are influenced by their own backgrounds, in addition to those of their corporation's component parts

Typical Process Architecture – Before Tailoring

**Organization/ Corporation** 



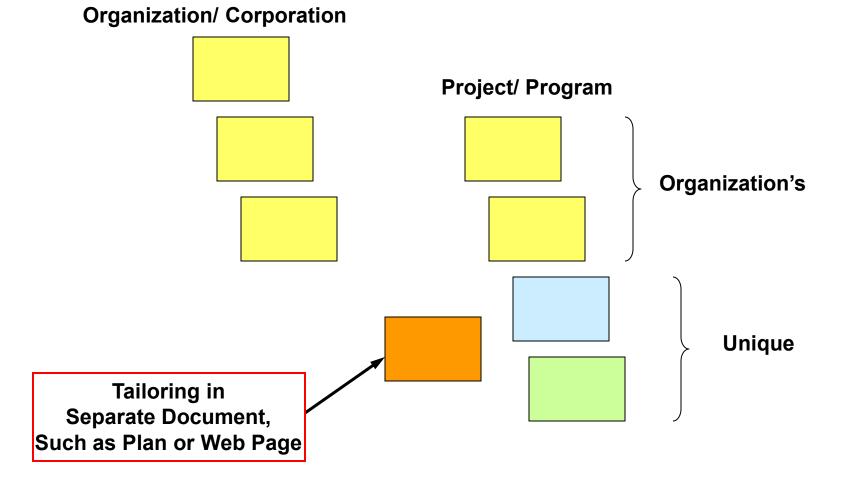
Typical Process Architecture – After Tailoring - #1

**Organization/ Corporation Project/ Program** Instantiation of Organization's, **Including Tailoring** Unique

Typical Process Architecture – After Tailoring - #2

**Organization/ Corporation Project/ Program** Organization's Unique, Including **Tailoring Documentation** 

Typical Process Architecture – After Tailoring - #3



### **Resolution Process**

- Two parts:
  - The project's tailoring guidelines
  - The corporation's and division's (the organization's) standard processes
- Authority to tailor flows down from the corporate management through tiers of its organization to a Process Group governing a project
  - Tailoring authority must meet diverse interests of the corporation
  - Must also meet the needs of the project for it to be CMMI "compliant" and maximize value to the project

# **Resolution Process (continued)**

- Major consideration is how good and how disciplined the corporation's standard processes are to begin with.
  - If the corporation has good process discipline and many practitioners trained in sophisticated techniques, it is easier to provide clear rules for tailoring because many of the issues have already been solved
  - A corporation with rambling, confusing process and procedure documents that just grew over time will have difficulty fitting tailoring provisions into them
    - Adding tailoring words to confusing text will still look confusing and be hard to understand and follow
    - When you consider tailoring, it often highlights the need to overhaul process and procedure documents
  - Most corporations are probably somewhere in middle

# **Special Factors in Resolution**

- Individual executive personalities are real (e.g., she has a "won't of iron" she won't give any flexibility)
- Standard process SMEs often have views (I would not have written that if I didn't want everyone to do it exactly that way.)
- Cost is a major consideration, but not always evaluated in same way
  - CMMI is often viewed as expensive, so authority should consider cost containment
  - Authority to add or elaborate may result in unnecessary added costs
  - Frequent process improvement activity can be "churning"
  - Process changes can result in need for more training expenditures
  - Appraisal and audit costs, including artifact costs, can rise with more tailoring
  - May result in unnecessary process differences across project or among similar projects, resulting in added costs
  - More tailoring increases process documentation costs
  - Corporations ask: Which process expenditures produce the most value? CMMI is not the only choice.
  - Is a business case needed for justification?
  - Does authority to delete or change contribute to added risk? Is any added risk properly managed?
  - How does CMMI activity fit with non-CMMI activity?
  - What is relationship to computer tools and their cost?
  - Is project workforce mostly experienced or "beginners"?
  - Is customer involvement present?
  - Does culture favor detail or brevity?

# How to proceed

- Need to identify the organization's set of standard processes and evaluate their suitability first
- If they are inadequate, we are talking about process changes and process improvements to the standard set before we ever get to tailoring for a project
- Need to put specific tailoring rules into organization's set of standard processes in order to enable them to be tailored in a predictable, disciplined way.
  - Top level for entire corporation can take a long time to coordinate, and can become too general
  - Limiting to one division or business unit may not have the right authority for higher level documents, but is easier to get approved
  - Choice of which standard process document to modify
  - Choice of where to document tailoring relates back to Organization's standard processes
    - For users to find it
    - For information for other projects
    - For configuration control
    - Relationship to other documents that may be modified
    - May be separate issue of where to document approval
    - Relationship to process improvements
  - Need to get attention of higher management and get on their priority list

## Result

- Tailored processes at project level fit into spectrum of higher level processes, same level processes, lower level processes and work instructions, standards, tool instructions, training materials, library or knowledge management assets, etc.
- I would like to be able to say that there is a perfect way to solve the Tailoring Dilemma, but there isn't.
- The best we can do is to indentify all of the applicable requirements and constraints and work through them in a rational and consistent way that meets the requirements and provides value.
- There will always be some people who will be unhappy.

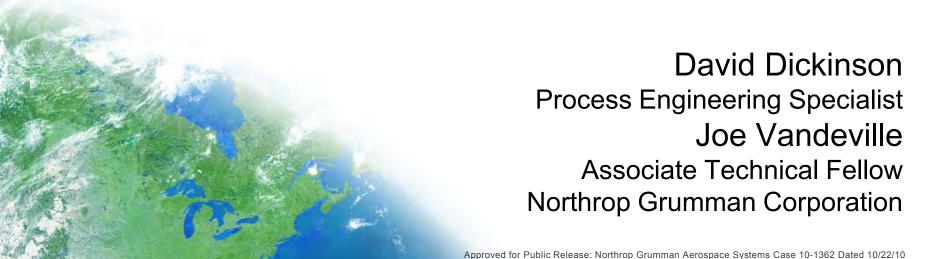
Don't be one of them!





## **Vertically Slicing the CMMI®**

## **November 17, 2010**



#### **Building Example**



Joe Process wants to build a building:



- How many stories (levels) in this building?
- How many levels initially? 2 Levels or Stories
- Does he have enough information to build the maximum number of levels (Say 5 levels is the maximum)?
- What is his implementation plan to minimize re-work if after building initially, Joe chooses to add additional levels to the building?
  - What are the plumbing requirements for a 5 story building?
  - Should all of these requirements be considered for the initial 2 story building?

If all requirements are not initially considered, there may be significant re-work

### Implementing CMMI®

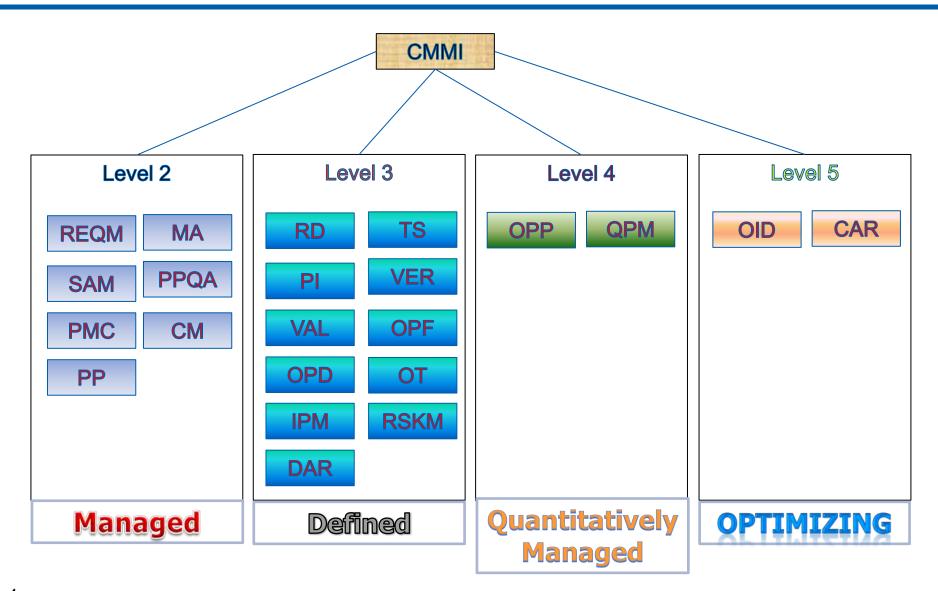


- How do YOU implement a Process System using the CMMI (and other process standards and requirements)
  - Lots of folks take it one level at a time
    - Advantage a very methodical approach, it allows you to focus on immediate process needs, helps build confidence in implementation
    - Disadvantage as you progress to higher levels, you may discover that a lower level implementation needs some rework or may not be robust enough to support the higher level implementation
  - However, a systems approach would suggest that decision analysis be used to select the best implementation
    - The CMMI practices (requirements) for ALL levels are known in advance
    - Analyze all requirements, and develop a concurrent (and phased) approach to optimize implementation cost by minimizing re-work
      - This is done by making a trade off of re-work vs. upfront costs

<sup>®</sup> CMMI is registered in the U.S. Patent and Trademark Office by Carnegie Mellon University

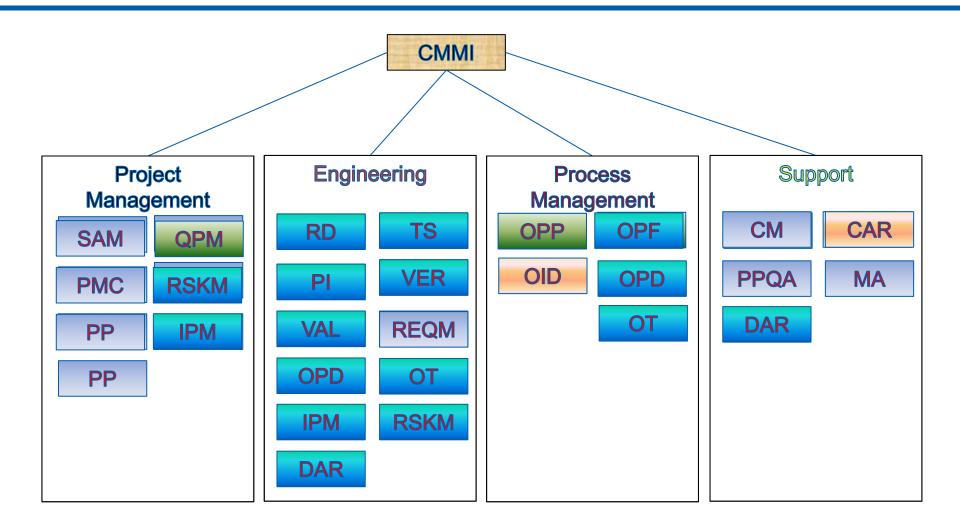
### Viewing CMMI Requirements by Levels





## Viewing CMMI Requirements by Categories





## Viewing CMMI Requirements by Functions



#### Analyze CMMI Requirements (Practices) to determine basic functions

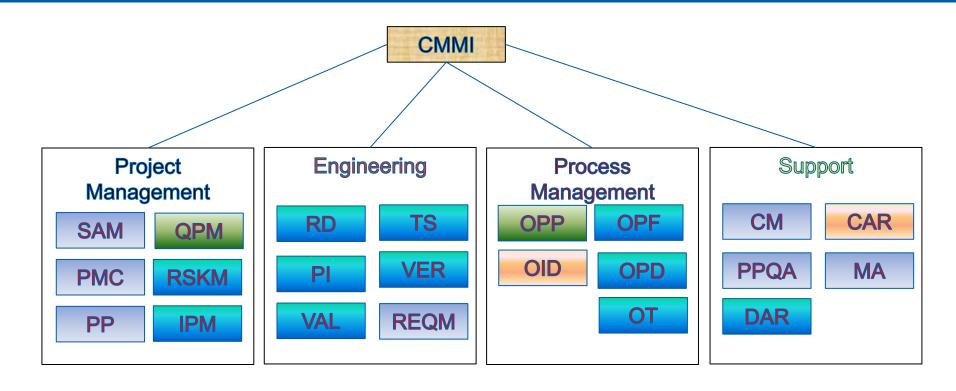
- Measure
- Analyze
- Reporting
- Evaluation
- Develop
- Review
- Document
- Maintain
- Gain Commitment
- Plan

- Report
- Select
- Establish Teams
- Communicate
- Monitor
- Deploy
- Train
- Achieve Traceability
- Control
- Etc

Perform Basic Functional Analysis and Allocation of CMMI Requirements

## Viewing CMMI Requirements by Functions





- Analyze
- Gain Commitment
- Achieve Traceability

- Analyze
- Measure
- Develop
- Review
- .

#### **Functional Analysis and Allocation**



#### Plan

IPM SP 1.4-1 Integrate other plans that affect the project with the project plan.
OPF SP 1.2-4 Plan, schedule, and prepare for the process appraisal.
OID SP 1.3-1 Plan the pilots.

#### **Gain Commitment**

PMC SP 2.2-3 Negotiate changes to internal and external commitments.

REQM SP 1.2-4 Negotiate and record commitments.

OPF SP 2.2-2 Negotiate and document commitments among the process action teams and revise their process action plans as necessary.

#### Measure

CAR SP 2.2-1 Measure the change in the performance of the project's defined process as appropriate.

DAR SP 1.4-3 Determine the measures needed to support the evaluation method.

OPD SP 1.4-6 Enter the specified measures into the repository.

#### **Monitor**

SAM SP 2.1-6 <u>Monitor</u> risks involving the supplier and take corrective action as necessary. RSKM SP 3.2-1 <u>Monitor</u> risk statue..

QPM SP 2.3-2 Monitor changes in quality and process-performance objectives and selected subprocess' process capability.

...

#### **Analyze**

QPM SP 2.2-5 Analyze the special cause of process variation to determine the reasons the anomaly occurred. REQM SP 1.1-3 Analyze requirements to ensure that the established criteria are met OPD SP 1.4-1 Determine the organization's needs for storing retrieving, and analyzing measurements.

#### Report

MA SP 1.4-4 Review and update the proposed content and format of the specified analyses and reports.

VER SP 3.2-4 Record all results of the analysis in a report.

CM SP 1.2-6 Create configuration management reports from the configuration management system.

#### Maintain

PI SP 1.2-5 Maintain the product integration environment throughout the project.

REQM SP 1.3-2 Maintain the requirements change history with the rationale for the changes.

IPM SP 1.3-3 <u>Maintain</u> the qualification of the components of the project's work environment.

...

#### **Document**

CM SP 1.3-3 <u>Document</u> the set of configuration items that are contained in a baseline.

DAR SP 1.2-6 <u>Document</u> the rationale for the selection and rejection of evaluation criteria.

MA SP 1.1-1 <u>Document</u> information needs and objectives.

...

#### **Examples of Functions**



#### Measure

CAR SP 2.2-1 Measure the change in the performance of the project's defined process as appropriate.

DAR SP 1.4-3 Determine the measures needed to support the evaluation method.

OPD SP 1.4-6 Enter the specified measures into the repository.

. . .

#### Analyze

QPM SP 2.2-5 <u>Analyze</u> the special cause of process variation to determine the reasons the anomaly occurred. REQM SP 1.1-3 <u>Analyze</u> requirements to ensure that the established criteria are met. OPD SP 1.4-1 Determine the organization's needs for storing, retrieving, and <u>analyzing</u> measurements.

...

#### **Measurement Function**



- Establish measures and objectives for determining the value of each process and technology improvement with respect to the organization's quality and process-performance objectives.
- Measure the value of each process and technology improvement.
- Measure the change in the performance of the project's defined process as appropriate.
- Identify how process performance is to be measured
- Identify the measures that are appropriate for statistical management.
- Revise the measures and statistical analysis techniques as necessary.
- Store process and product measures in the organization's measurement repository.
- Define a common set of process and product measures for the organization's set of standard processes.
- Collect performance measures on the risk-handling activities.
- Update measures and measurement objectives as necessary.
- Obtain the data for base measures.
- Review the results of collecting and analyzing measures for controlling the project.

**OID SP 2.1-4** 

**OID SP 2.2-1** 

**CAR SP 2.2-1** 

QPM SP 1.1-3

**QPM SP 2.1-3** 

**QPM SP 2.1-8** 

**IPM SP 1.6-2** 

OPD SP 1.4-2

**RSKM SP 3.2-6** 

MA SP 2.1-1

MA SP 1.4-5

**PMC SP 1.6-2** 

#### **Analyze Function**



Analyze the costs and benefits of potential innovative improvements.

**OID SP 1.2-4** 

 Analyze selected defects and other problems to determine their root causes.

CAR SP 1.2-2

• Establish and maintain the organization's process-performance baselines from the collected measurements and analyses.

OPP SP 1.4-2

 Analyze the interaction of subprocesses to understand the relationships among the subprocesses and the measured attributes of the subprocesses.

**QPM SP 1.2-3** 

 Analyze the special cause of process variation to determine the reasons the anomaly occurred.

**QPM SP 2.2-5** 

 Select the methods based on the purpose for analyzing a decision and on the availability of the information used to support the method.

**DAR SP 1.4-1** 

Analyze the organization's common set of measures.

OPF SP 3.4-5

Analyze issues to determine need for corrective action.

PMC SP 2.1-2

Analyze the impact of changes and fixes proposed in the change requests.

CM SP 2.1-2

 Specify and prioritize the analyses that will be conducted and the reports that will be prepared

MA SP 1.4-1

• Analyze requirements to ensure that the established criteria are met.

**REQM SP 1.1-3** 

### **Analyze Defects Function**



#### Analyze Defects or other issues for *preventive* action

Analyze selected defects and other problems to determine their root causes.

**CAR SP 1.2-2** 

 Analyze the special cause of process variation to determine the reasons the anomaly occurred.

**QPM SP 2.2-5** 

#### Analyze Defects or other issues for *corrective* action

Analyze issues to determine need for corrective action.

IPM SP 2.1-2

Analyze the impact of changes and fixes proposed in the change requests.

CM SP 2.1-2

In Implementing the Analyze Defect function we can now decide whether to address this function for corrective only or for both corrective and preventive action with full knowledge of all the requirements

#### Summary: "Vertically Slicing the CMMI®"



Since all CMMI requirements are known beforehand the following holistic approach can be employed to proactively build the foundation for all levels:

- Analyze the CMMI practices across all maturity levels,
- Understand their interrelationships
- Decompose the CMMI into functions with allocated requirements otherwise known as Functional Analysis and Allocation (FAA)
- Plan for a time phased optimal implementation by making decisions about what requirements will be implemented in each phase

Therefore, "Vertical Slicing the CMMI" really equates to using good system engineering principles to enable good decisions on what requirements are addressed in each phase of implementation so that re-work in minimized as progressively higher CMMI levels are implemented

# NORTHROP GRUMMAN



# Measurement Planning and Data Collection



Name: William Golaz

Title: LM Fellow & LM Aero Measurement

and Analysis Lead

## **Topics**



- Background
- Deploy measurement process across programs
- Collect measurement usage across the company
- Evaluate measures for commonality and standardization
- Summary



#### **Lockheed Martin Aeronautics Overview**



## 29,000 employees across the company and around the world



# **Background**



- Lockheed Martin Aeronautics measurement process improvements
  - Multi site measurement programs pre 2000
  - Programs specific measures and formats pre 1993
  - SEI CMM Level 3 for software 1993
    - SW Standard Metrics
  - SEI CMM Level 4 for software 1999
    - SW Quantitative Management
    - Common Repository for all SW measurement data
  - SEI CMMI Level 3 at company level 2007 & 2010
    - Company wide measurement process



# Use of measures across the company



- How to collect data on measurements used across the company and provide value added to the programs
  - Institutionalize the Measurement & Analysis (M&A) process
  - Identify common measurement needs across the programs
  - Standardize M&A planning across the company
  - Streamline M&A planning for the programs



# **Approach**



- Establish a method to collect data on measurement indicators while using it to pre-populate program M&A plans
  - Establish Measurement Model Database
    - Measurement Objectives, Information Needs, and Measurement Indicators
  - M&A planning workshops on site with the programs facilitated data collection and distribution of common measurement planning data
  - Pre-populate M&A planning templates using data in the database

**Generate Measurement Matrix for each program** 



# Approach (cont.)



- Measurement Matrix (MS Excel Work Book)
  - Measurement Objectives
  - Information Needs
  - Measurement Indicators
  - Base Measures
  - Program briefings where indicators are used
  - Program owners of the indicators
- Matrix is a part of program M&A plans
  - Replaces multiple traceability tables
- Matrix is generated from Measurement Model database



# Approach (cont.)



- Resources:
  - Pre-populated M&A plan template
    - Common objectives, information needs and measures
    - Boiler plate information
    - Training
    - References to standard process
  - Measurement Model Database
    - Specification data for standard measures
    - Common objectives and information needs
    - Able to generate tables for M&A plan
    - Collect program specific measures



# **Measurement Plan Template**

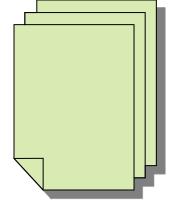




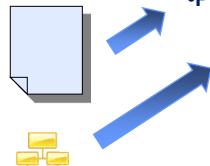


- Standard Measures
- Standard tools
- Documentation standards
- Organization
- Process standards



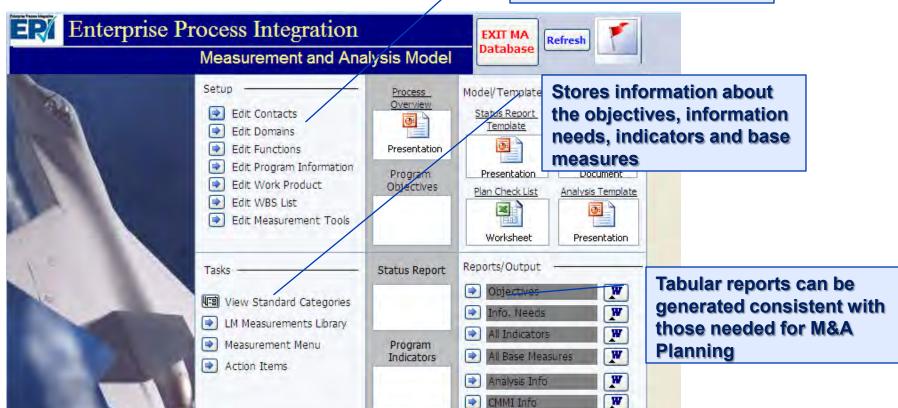


**Measurement Plan Template** (Pre-populated)



## **Measurement Model**





Can be used to generate a Measurement Matrix for any program or function

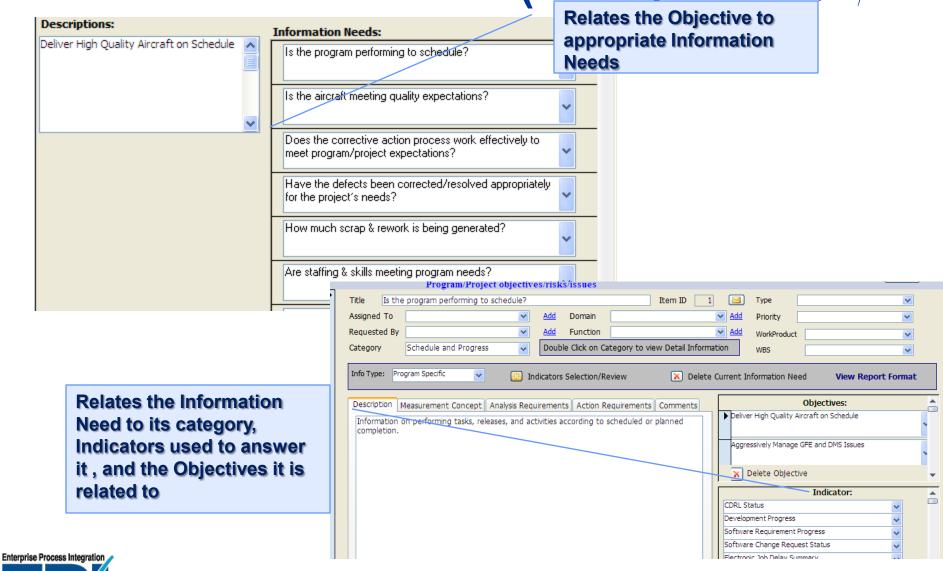


Measurement Model (cont.) **Collect information about** the objectives Measurement and Analysis Model List the objectives Objectives Input Information Needs Input LM Measurements Library I Undata Calacted Indicate Collect information about Objectives Information Needs the Information Needs Action It Deliver High Quality Aircraft on Is the program performing to Schedule schedule? Aircraft. **List the Information Needs** Aircraft A Aggressively Manage GFE and DMS Is the aircraft meeting quality Approved CRs expectations? ssues Automated Request for Engineering Action BTP Commit Plan Proactively Manage Configuration Does the corrective action process BTP Need Plan Control of Each Aircraft and the RERP work effectively to meet (C-5M) Baseline program/project expectations? Cash vs. Time CDRL Status Manage timely Procurement of all How much scrap & rework is being supplier required products for C-5 generated? Change Request by Category programs Closed DRs by Resolution CM CCB CR Cycle Time Collect information about the Minimize Waste to program? Affordable Product CM OOS CR Disposition Index **Measurement Indicators** and Contribute to F

> List the Measurement **Indicators**



Measurement Model (cont.)



# Measurement Model (cont.)



|   | LM-Aero Library                                       | of Indicators - Detail Inform     | nation Close<br>Form       |  |  |
|---|---|-----------------------------------|----------------------------|--|--|
| Þ | Measures Wiring harness completion status             | Change Status of current measure  | Delete Current Indicator   |  |  |
|   | OSP: Table I  | References: MM Program Specific   | Add New Indicator          |  |  |
|   | Measurement Category: Process Performance             | Appendix N/A Required/Optional: O | LM Measurement Library     |  |  |
|   | This measures Answers Questions Such as: Are we comp  | All Indicators Report             |                            |  |  |
|   | Implementation Guidance: Analysis Frequency:          | Review Frequency:                 | Current Indicator Report   |  |  |
|   | Storage Requirements:                                 | Org. Repository:                  | Program Indicators Rpt     |  |  |
|   | Collection Level:                                     | Reporting Level:                  | Function Indicators Rpt    |  |  |
|   | Collection Requirements:                              | Collection Frequency:             |                            |  |  |
|   | CMMI Process Areas:                                   |                                   | Base Measure Name          |  |  |
|   | OPF: OPD: OT: OPP: OID: PP:                           | PMC: SAM: PM: RSKM: QPM:          | <u> </u>                   |  |  |
|   | REQM: RD: TS: PI: VAL: VER:                           | CM: PPQA: MA: DAR: CAR:           |                            |  |  |
|   | Purpose:  |                                   |                            |  |  |
|   | Description of Measures   Measurement Objectives   Pu |                                   |                            |  |  |
|   |   |                                   | Delete Current BaseMeasure |  |  |
|   |   |                                   | Indicator Tool             |  |  |
|   |   |                                   | Indicator 1001             |  |  |

Collect detailed information about each measurement indicator Can generate specification table for each or all indicators



## **Measurement Matrix**

| - 4      | Y   | Z      | AA      | AB                                 | AC                                   | AD   | AE                   | AF             |
|----------|---|--------|---------|------------------------------------|--------------------------------------|--|----------------------|----------------|
| 1        |   | ireORO | Appendi | Category                           | Question                             | Purpose  | Objective            | Descriptic     |
| 2        | Automated Request for Engineering<br>Action Metrics | R      | Α       | Process Performance                | E.S. 001                             | AREA Standard Metrics Deck includes 15 me  | Track AREAs to       | Multiple bar/l |
| 3        | BTP Commit Plan                                     | R      | А       | Process Performance                | E.S.001                              | Tracks performance to the Commit Plan. This  | Track BTP perfro     | Chart showin   |
| 4        | BTP Need Plan                                       | R      | А       | Process Performance                | E.S.001                              | Tracks performance to Need Plan. The latest  | Tracks drawings)     | Tracks drawii  |
| 5        | Cash vs. Time                                       | 0      | А       | Resource and Cost                  | B.S.008; B.S.010                     | Determine whether program is meeting comp.   | Provide executiv     | Plan vs. Actu  |
| 6        | CM CCB CR Cycle Time                                | R      | А       | Process Performance                | E.S. 004; E.S. 005; E.S.             | Track the performance of the formal change r   | Identify potential i | This measure   |
| 7        | CM OOS CR Disposition Index                         | R      | Α       | Process Performance                | E.S. 005; E.S. 006                   | Tracks the disposition of formal CRs.  | Identify potential i | Compares th    |
| 8        | Cost Performance                                    | С      | А       | Resource and Cost                  | B.S.001; B.S.002; B.S.0              | Provide insight into the actual labor expenditu  | ldentify risks to th | The earned v   |
| 9        | Cost Performance Index                              | С      | А       | Resource and Cost                  | B.S.001; B.S.002; B.S.0              | Represent actual cost expenditure to budgete   | Identify risks to th | (CPI indicates |
| 10       | Cost Variance                                       | С      | Α       | Resource and Cost                  | B.S.001; B.S.002, B.S.0              | Identify variance of actual labor expenditures t   | Indicate if project  | This earned u  |
| 11       | CPU Throughput                                      | С      | Α       | Product Size and Stability         | C.S 004; C.S.005; C.S (              | Compare actual to expected computer resour   | Identify computer    | This measure   |
| 12       | Defect Burndown                                     | С      | Α       | Product Quality                    | D.S.003; D.S.006, D.S.0              | Identify how long it will take to correct the defe   | Identify impacts to  | The Defect E   |
| 13       | Defect Profile Table                                | R      | Α       | Product Quality                    | D.S001; D.S.002; D.S.0               | Identify how many defects are detected and in  | Represent produ      | The defect pr  |
| 14<br>15 | Defects by Category Defects by Severity             | R<br>C | A<br>A  | Product Quality<br>Product Quality | D.S.001; D.S.004<br>D.S.002; D.S.003 | Identify the number of defects per defect cate<br>Identify the number of defects per defect seve |                      |                |
| 16       | Delivery Status                                     | 0      | А       | Schedule and Progress              | A.S.008; A.S.009                     | Indicates whether final product deliverables ar  | To control final o   | Count of plan  |
| 17       | Earnings Before Interest & Taxes (EBIT) vs. Time    | 0      | А       | Resource and Cost                  | B.S.008; B.S.009                     | Determine whether program is meeting comp.   | Provide executive    | Plan vs. Actu  |
| 18       | Input/Output Utilization                            | С      | А       | Product Size and Stability         | C.S.004; C.S.005; C.S.0              | Compare actual to expected utilization of inte   | Identify computer    | This measure   |
|          | Objective-Info / Info                               | Needs  | Info    | Measures AllMeasure                | IndicatorTo                          | ols / IndicatorBase / BaseMeas   | sures / Ques         | tions          |



Generated from the Measurement Model database

Each tab replaces a table in the M&A Plan

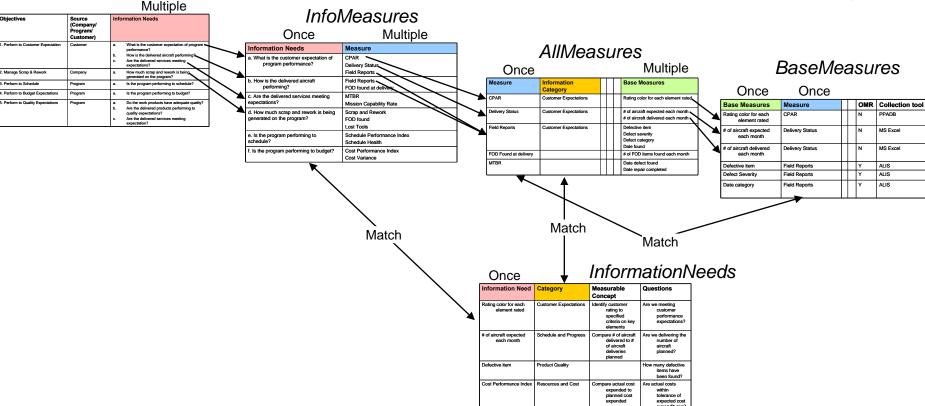
- •Measurement Objectives and their associated Information Needs
- •Information Needs mapped to standard categories and the Indicators used for each Information Need
- Specification details about each Indicator
- Base Measures used for each Indicator



## **Relationship of Measurement Matrix**

**Tables** Objectives-Info



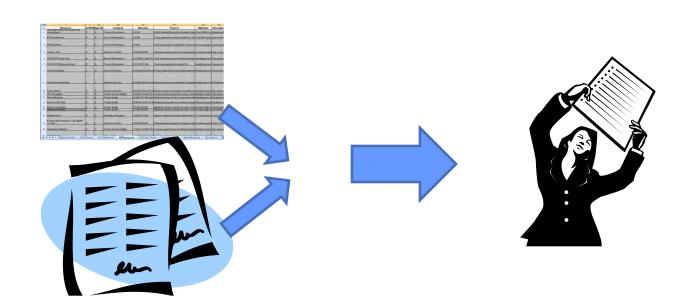


Each Objective may map to multiple Information Needs. Each Information Need can map to multiple Indicators. Each Indicator may use multiple Base Measures. Indicator details includes an owner for each measure and what management briefings include the measure. Indicators can be sorted by owner, briefing, category, etc for program use.

## Program Measurement and Analysis Plan



Measurement Matrix is combined with Measurement Plan template to create program Measurement Plan

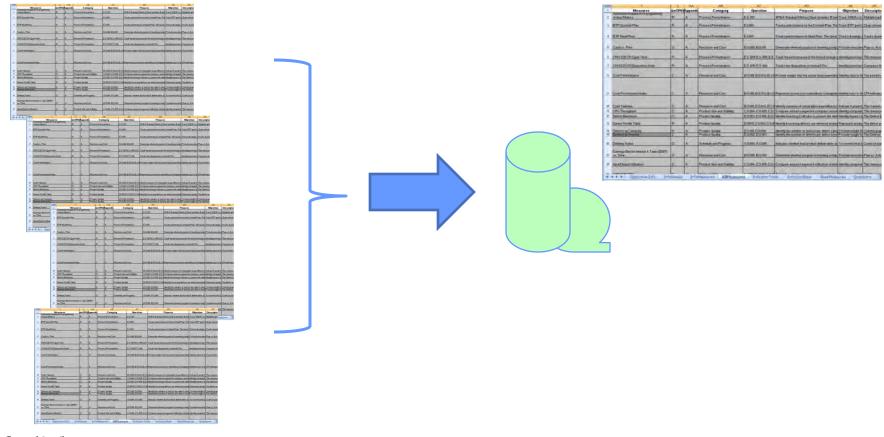




# Organizational Analysis of Measurement Planning Data



Load program measurement matrices into organizational Measurement Model





# Organizational Analysis of Measurement Planning Data



- •Evaluate which measures are common across programs
- •Used M&A Working Group to down select those to add to the company standard set of measures

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Programs are represented on M&A WG



# **Summary**



- Deployed Measurement and Analysis (M&A) process to all programs
- Streamlined Measurement and Analysis planning for the programs
- Standardized M&A Planning across the programs
- Collected measurement usage across the company
- Updated the set of standard measures based on results



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# A CMMI-Compliant Project Plan (in Less Than 10 Pages)

CMMI Technology Conference and User Group 15-18 November 2010



Ferol Lewis and Rick Hefner Northrop Grumman Corporation

## Background



- Most CMMI adopters continue to write plans the traditional way -- hundreds of pages long, filled mostly with boilerplate
- This approach is not consistent with the CMMI model, and makes the plans difficult (and time-consuming) to create, use, and maintain
- This presentation will describe a simple, easy to use method for creating a short (less than 10 pages), CMMIcompliant project plan

## Topics



- CMMI planning practices (PP, IPM, GP 2.2)
- Policy, plans, process descriptions, procedures what's the difference?
- A 10-page (or less) planning template
- Lessons learned

## **CMMI Planning Practices**



 Planning is mentioned both as a process area and as a generic practice in all process areas

|         |  | Requirements Management | Project Planning | Project Monitoring and Control | Supplier Agreement Management | Measurement and Analysis | Process and Product Quality Assurance | Configuration Management | Requirements Development | Technical Solution | Product Integration | Verification | Validation | Organization Process Focus | Organization process definition | Organizational Training | Integrated Project Management | Risk Management | Decision Analysis and Resolution | Organizational Process Performance | Quantitative Project Management | Organizational Innovation and Deployment | Causal Analysis and Resolution |
|---------|--|-------------------------|------------------|--------------------------------|-------------------------------|--------------------------|---------------------------------------|--------------------------|--------------------------|--------------------|---------------------|--------------|------------|----------------------------|---------------------------------|-------------------------|-------------------------------|-----------------|----------------------------------|------------------------------------|---------------------------------|--|--------------------------------|
| GP 2.1  | Establish an Organizational Policy         |                         |                  |                                |                               |                          |                                       |                          |                          |                    |                     |              |            |                            |                                 |                         |                               |                 |                                  |                                    |                                 |  |                                |
| GP 2.2  | Plan the Process                           |                         | 7                |                                |                               |                          |                                       |                          |                          |                    |                     |              |            |                            |                                 |                         |                               |                 |                                  |                                    |                                 |  |                                |
| GP 2.3  | Provide Resources                          |                         |                  |                                |                               |                          |                                       |                          |                          |                    |                     |              |            |                            |                                 |                         |                               |                 |                                  |                                    |                                 |  |                                |
| GP 2.4  | Assign Responsibility                      |                         |                  |                                |                               |                          |                                       |                          |                          |                    |                     |              |            |                            |                                 |                         |                               |                 |                                  |                                    |                                 |  |                                |
| GP 2.5  | Train People                               |                         |                  |                                |                               |                          |                                       |                          |                          |                    |                     |              |            |                            |                                 |                         |                               |                 |                                  |                                    |                                 |  |                                |
| GP 2.6  | Manage Configurations                      |                         |                  |                                |                               |                          |                                       |                          |                          |                    |                     |              |            |                            |                                 |                         |                               |                 |                                  |                                    |                                 |  |                                |
| GP 2.7  | Identify and Involve Relevant Stakeholders |                         |                  |                                |                               |                          |                                       |                          |                          |                    |                     |              |            |                            |                                 |                         |                               |                 |                                  |                                    |                                 |  |                                |
| GP 2.8  | Monitor and Control the Process            |                         |                  |                                |                               |                          |                                       |                          |                          |                    |                     |              |            |                            |                                 |                         |                               |                 |                                  |                                    |                                 |  |                                |
| GP 2.9  | Objectively Evaluate Adherence             |                         |                  |                                |                               |                          |                                       |                          |                          |                    |                     |              |            |                            |                                 |                         |                               |                 |                                  |                                    |                                 |  |                                |
| GP 2.10 | Review Status with Higher-Level Manageme   | nt                      |                  |                                |                               |                          |                                       |                          |                          |                    |                     |              |            |                            |                                 |                         |                               |                 |                                  |                                    |                                 |  |                                |
| GP 3.1  | Establish a Defined Process                |                         |                  |                                |                               |                          |                                       |                          |                          |                    |                     |              |            |                            |                                 |                         |                               |                 |                                  |                                    |                                 |  |                                |
| GP 3.2  | Collect Improvement Information            |                         |                  |                                |                               |                          |                                       |                          |                          |                    |                     |              |            |                            |                                 |                         |                               |                 |                                  |                                    |                                 |  |                                |

## What Might Be Included in a Plan?



#### **GP 2.2 Plan the Process**

Establish and maintain the plan for performing the process.

The plan for performing the process typically includes the following:

- Process description
   GP 3.1
- Standards and requirements for the work products and services of the process
- Specific objectives for the performance of the process (e.g., quality, time scale, cycle time, and resource usage)
- Dependencies among the activities, work products, and services of the process
- Resources (including funding, people, and tools) needed to perform the process **GP 2.3**
- Assignment of responsibility and authority
- Training needed for performing and supporting the process
- Work products to be controlled and the level of control to be applied
- Measurement requirements to provide insight into the performance of the process, its work products, and its services
- Involvement of identified stakeholders
- Activities for monitoring and controlling the process
- Objective evaluation activities of the process
- Management review activities for the process and the work products

## **CMMI Planning Process Areas**



#### **Project Planning**

#### SG 1 Establish Estimates

- SP 1.1 Estimate the Scope of the Project
- SP 1.2 Establish Estimates of Work Product and Task Attributes
- SP 1.3 Define Project Lifecycle
- SP 1.4 Determine Estimates of Effort and Cost

#### SG 2 Develop a Project Plan

- SP 2.1 Establish the Budget and Schedule
- SP 2.2 Identify Project Risks
- SP 2.3 Plan for Data Management
- SP 2.4 Plan for Project Resources
- SP 2.5 Plan for Needed Knowledge and Skills
- SP 2.6 Plan Stakeholder Involvement
- SP 2.7 Establish the Project Plan

#### SG 3 Obtain Commitment to the Plan

- SP 3.1 Review Plans that Affect the Project
- SP 3.2 Reconcile Work and Resource Levels
- SP 3.3 Obtain Plan Commitment

#### **Integrated Project Management**

#### SG 1 Use the Project's Defined Process

- SP 1.1 Establish the Project's Defined Process
- SP 1.2 Use Organizational Process Assets for Planning Project Activities
- SP 1.3 Establish the Project's Work Environment
- SP 1.4 Integrate Plans
- SP 1.5 Manage the Project Using the Integrated Plans
- SP 1.6 Contribute to the Organizational Process Assets

## SG 2 Coordinate and Collaborate with Relevant Stakeholders

- SP 2.1 Manage Stakeholder Involvement
- SP 2.2 Manage Dependencies
- SP 2.3 Resolve Coordination Issues

## Other CMMI Planning Implications



- Words like "designated", "identify", "select" in other practices imply a choice to be made in planning
- GP 2.6 Place designated work products of the process under appropriate levels of control.
- GP 2.7 *Identify* and involve the relevant stakeholders of the process as planned.
- PPQA SP 1.1 Objectively evaluate the designated performed processes against the applicable process descriptions, standards, and procedures.

### How do Plans and Process Descriptions Differ?



#### Plan

- Description of activities
- Resources (including funding, people, and tools)
- Schedule
- Assignment of responsibility and authority

**GP 2.4** 

**GP 2.3** 

#### At Level 2, plans describe what to do

At Level 3, the existence of a process description means that plans become much shorter

 Focus is on instantiating the process (e.g., how often a process executes)

#### **Process Description**

**GP 3.1** 

- Process roles
- Applicable process and product standards
- Applicable procedures, methods, tools, and resources
- Process performance objectives
- Entry criteria
- Inputs
- Product and process measures to be collected and used
- Verification points (e.g., peer reviews)
- Outputs
- Interfaces
- Exit criteria

## A Top-Level Comparison





Policy High-level "what" to do

(organizational guidance)



Process High-level "how" to do

(organizational standard, tailored by projects)



Procedure Low-level "how" to do

(details needed to follow a strategy)



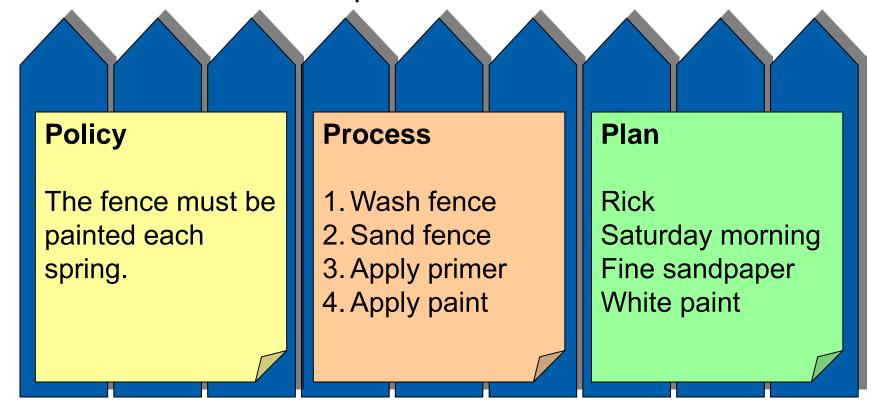
Plan Instantiation of the process

(how often, when, etc.)

## **Documenting Choices in Plans**



- Policies identify what must happen
- Process descriptions and procedures describe the steps to be performed
- Plans describe how the process is instantiated



### **Bottom Line**



- For Level 3 and higher organizations, the existence of a process description means the typical "boilerplate" process descriptions included in a plan (e.g., DOD-STD-2167A) can be eliminated
- Plans simply describe the instantiation of the process
  - Who, how often, what resources
- Plans capture the <u>decisions</u> about how to best fit the process to the task at hand
  - By creating a short, table-based template, the decisions are highlighted

## Plan Template



The work products to be controlled for each project process, their level of control, and the control authority authorized to make changes to the work product are defined in Table 2.10. The levels of control are defined in Table 2.11

Table 2.10. Work Products, Documents, and Records

| Table 2.10. Work Products, Documents, and Records |   |                  |                 |  |  |  |  |  |  |  |
|---|---|------------------|-----------------|--|--|--|--|--|--|--|
| PROJECT PROCESS                                   | WORK PRODUCT                                | LEVEL OF CONTROL | AUTHORITY       |  |  |  |  |  |  |  |
| Project Planning                                  | Project Management Plan                     | Project          | Project Manager |  |  |  |  |  |  |  |
|   | Engineering Change Proposals<br>(CDRL A017) | Project          | Project Manager |  |  |  |  |  |  |  |
| Project Monitor and Control                       | Work Breakdown Structure                    | Project          | Project Manager |  |  |  |  |  |  |  |
|   | Technology Control Plan (CDRL<br>A001)      | Project          | Project Manager |  |  |  |  |  |  |  |
|   | Contract/Funds Status Report<br>(CDRL A003) | Project          | Project Manager |  |  |  |  |  |  |  |
|   | Cost-Schedule Status Report<br>(CDRL A004)  | Project          | Project Manager |  |  |  |  |  |  |  |

- All CMMI-required decisions are captured in the template
- The template can include either blanks to fill in, "typical" values to be reviewed/modified as needed, or mandatory values set by the organization

### **Lessons Learned**



- The template has been a very useful tool for explaining CMMI concepts
- The table approach encourages Project Managers to be more conscientious in their process decisions
- Short plans make them easy to use no more shelfware

## NORTHROP GRUMMAN

# **Getting Performance From Process** Improvement





#### **Contents**

#### **Content**

In Search of the Missing Link
Between Process and Performance

What is Process "Improvement" 17

Improving Performance
Through Process Improvement 25



## **Answering the Mail**

Dr. Ashton Carter, DoD Assistant Secretary AT&L, advised industry of a new program with the goal of increasing warfighting capabilities by three percent without proportionately higher budgets.

NDIA responded with 58 recommendations. Only my late entry addressed CMMI and organizational performance.

We can answer the mail, but only by talking about performance, not just the CMMI or maturity levels.



#### What We Believe

There is a pervasive belief in the defense contracting industry that the achievement of CMMI maturity levels, ISO/AS registrations, or DO-178 compliance mean that we have:

- Improved our processes
- Improved organizational and project performance
- Improved the quality of our products and systems
- Become more effective and efficient

How many of us ever ask the question: Is this true?

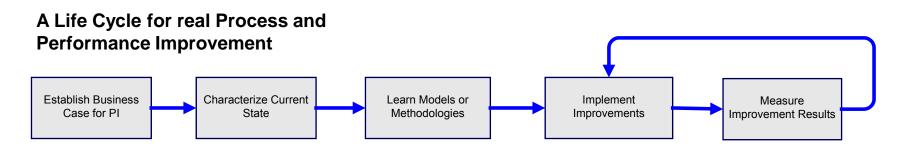


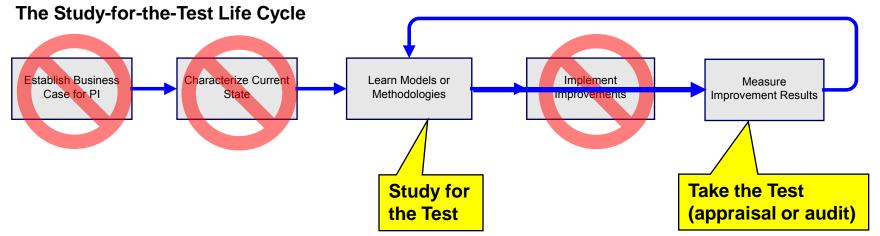
## Things That Used to Mean Something<sub>1</sub>





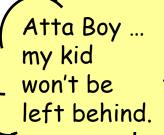
## Things that Use to Mean Something<sub>2</sub>: The Changing Process Improvement Life Cycle



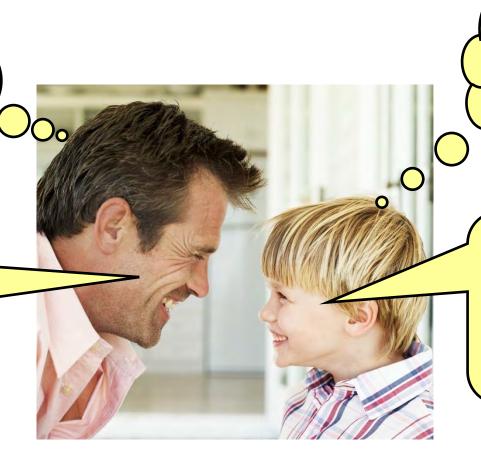




## Things That Used to Mean Something<sub>3</sub>



Hey Son, How's school going?



Great Dad!
I kant reed
or rite, but
I past the
test!

Report Card

**CMMI** 

ML<sub>3</sub>



## Perception and Hyperbole Have Won

If the status is **Green**, it's **Green**!

If your organization has been rated Maturity Level 3, then it's Maturity Level 3.

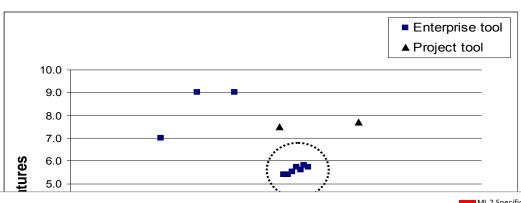
Whether or not there are facts, measures, details, or analyses supporting the perception is irrelevant. Whether or not there was improvement is irrelevant. Whether or not the SCAMPI method was even conducted is irrelevant.

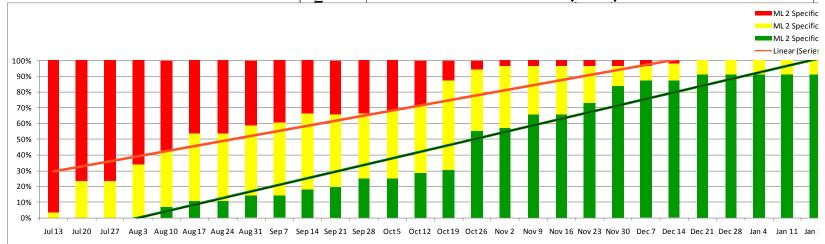
Sadly, perception and hyperbole have won.



## The Dumbing Down of Facts and Measures<sub>1</sub>

Why do the hard work of trying to understand measures or measurement data ...







## The Dumbing Down of Facts and Measures<sub>2</sub>

When we can just look at red-yellow-green charts that can mean anything, nothing, or whatever we want it to mean.





#### The CMMI and Performance

## **CMMI**

Operational Excellence

**Robust process** 

**Maturity Level** 

## <u>Performance</u>

#

#



**Efficiency** 

lean/flexible

Performance measures



## What Do CMMI Maturity Levels Mean?

- ML 2 You manage process performance, and your performed processes are consistent with the practices defined in ML 2 (at CL 2) in the CMMI.
- ML 3 You manage process performance in accordance with a defined process, and your performed and defined processes are consistent with the practices defined in ML 3 (at CL 3) in the CMMI.
- ML 4 You quantitatively manage your processes, and your performed and defined processes are consistent with the practices defined in ML 4 (at CL 3) in the CMMI.
- ML 5 You quantitatively optimize your processes, and your performed and defined processes are consistent with the practices defined in ML 5 (at CL 3) in the CMMI.

Nowhere in the CMMI does it say that achieving a maturity level means the organization or projects have improved business performance.



## What Do CMMI Maturity Levels Mean?<sub>2</sub>

When a Tier 1 contractor, achieves a maturity level, it's touted it in press releases as reaching "the high bar." But in sub-tier vendor/supplier selections, CMMI maturity levels are expressed as the "minimum entry criteria," a.k.a., "the low bar."

Why?

## In Search of the Missing Link Between Process and Performance

## What Do CMMI Maturity Levels Mean?<sub>3</sub> The Economic Basis of CMMI Commoditization

- Intrinsic value isn't
- So then, what is the perceived value of the CMMI?
- In economics, perceived value for commodities and assets are assigned a proxy (currency, shares) with which the commodity/asset is bought, sold, and traded
- □ So then, what is the proxy for the CMMI?
- The proxy for the CMMI has become appraisals and, specifically, maturity levels
- And the SEI has set up close to 500 SEI Partners as their own mints, to print as much currency as they want



What is one of the common consequences of flooding the economy with currency?



## How We Know What Isn't So\*<sub>1</sub>

So, why do we believe that CMMI maturity levels (or ISO registrations, etc) represent improved performance?

- Because we want to believe
- Because someone in a position of authority said so
- □ Because we live in a culture that cannot or does not distinguish correlation from causation
- Because CMMI maturity levels are much easier to achieve than real process and performance improvement
- Because of the way the CMMI is sold to us

## In Search of the Missing Link Between Process and Performance

# How We Know What Isn't So\*<sub>2</sub>

When the "benefits" of CMMI use are presented or published, only a subset of the entire set of possibilities are addressed.

Successful Unsuccessful organizations organizations This is the What is the size subset of **Organizations** organizations of this subset that use the touted to **CMMI** relative to the promote CMMI adoption. superset? What is the size What is the size **Organizations** that don't use of this subset of this subset the CMMI relative to the relative to the superset? superset?

# What Is Process "Improvement?"



## What do You Think is Process Improvement?

What do you do in your organization that you call "process improvement?"



## What is Provably Not Process Improvement

The notion that simply documenting your processes and procedures in a way that reflects practices in the CMMI or standards (ISO 9000, TL 9000, AS 9100, DO-178) constitutes "process improvement" is false because:

- □ Performance improvement can only be achieved in the performance of the process, not the definition of process
- Even if there was high fidelity between your defined processes and performed processes, how does a adoption of "best practices" equate to the high bar for process performance?

## The Question Never Asked<sub>1</sub>: Why Are We Doing This?

Why? Is the most important, yet most overlooked, question to ask and to answer. Before your organization begins planning a goal and measurement project, ask and answer these questions:

- What business are we in?
- □ What do we need to improve, and why? (How do we know we're not already doing something well enough?)
- □ If we produce results goals and measures will anyone value or use them?
- What is our level of ignorance? Do we have the slightest idea what we're doing? Are we competent?

The leadership question of the Modern era was, "Can we ...?" In the post-modern era, that question is now moot. The leadership question of our era is, "Should we ...?" and, if so, "Why?"



## The Question Never Asked<sub>2</sub>: The Pursuit of the False Goal

As leaders, we are still addressing "What can we do?" not "What should we do?"

The false goals pursued using the CMMI:

- Maturity Levels
- □ Consistency (for its own sake)
- Quality (for its own sake)

The pursuit of a CMMI maturity level and the pursuit of measurable performance improvement are not mutually exclusive (but we unconsciously treat them as if they were.)



## When the "R" is the "Why"

Example

When striving to achieve a performance goal, organizations often care about a positive <u>Return On Investment</u> (ROI). If we ask "why" enough times, we will eventually understand the real goal. For example ...

**Draft goal:** We will standardize our processes.

Question: Why?

**Answer:** So that people perform their work the same way.

Question: Why?

**Answer:** Because then we'll reduce waste and rework associated with

"reinventing" things.

Question: Why?

**Answer:** As an organization, we can produce more deliverables with

the same resources if people reuse work products.

**New goal:** Improve productivity by n% annually.



### **Improving Defined Processes**

When I improve my <u>defined</u> processes, some of the improvement activities my organization will do include:

- Create new process representations or change existing process representations so that people find them more adoptable, adaptable, and helpful
- Make my process representations more accessible
- Make my process representations more intuitive
- Make my process representations easier to change with changes in the business
- Change the process representations such that people comprehend them quicker and can use them more effectively and efficiently
- □ Lower the cost of process definition and maintenance



## **Improving Performed Processes**

When I improve my <u>performed</u> processes, some of the improvements we can make include:

- Reduce the amount of time required to perform the process
- Make the performance of process count; make every task or step yield a work product, or a change of state to a work product (i.e., never have activity that yields nothing but activity; activity ≠ work)
- Make process performance yield higher quality work products (but only if a quality goal is justified by a higher business goal)
- Make the performance of process something that is natural and intuitive to people
- Make process performance rewarding to individuals

# Improving Performance Through Process Improvement



## 3 Things You Can Change to Improve Performance

There are only three things you can change to improve business performance:



Improving skills, knowledge, and learning can affect productivity and quality.



Improving technology can affect delivery cycle time through greater automation.



Improving processes can contribute to greater effectiveness, efficiency, and quality via process performance.

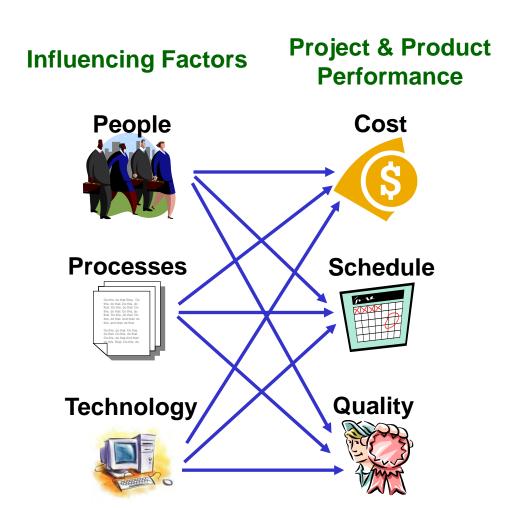


## Measuring What We Improve<sub>1</sub>

# Measure what you improve:

If we improve processes but then measure project or product performance, our measures are "muddled" and results are speculative.

When we improve processes and measure processes, we reduce the variability of influencing factors, and our measurement information is more meaningful.





## Measuring What We Improve<sub>2</sub>

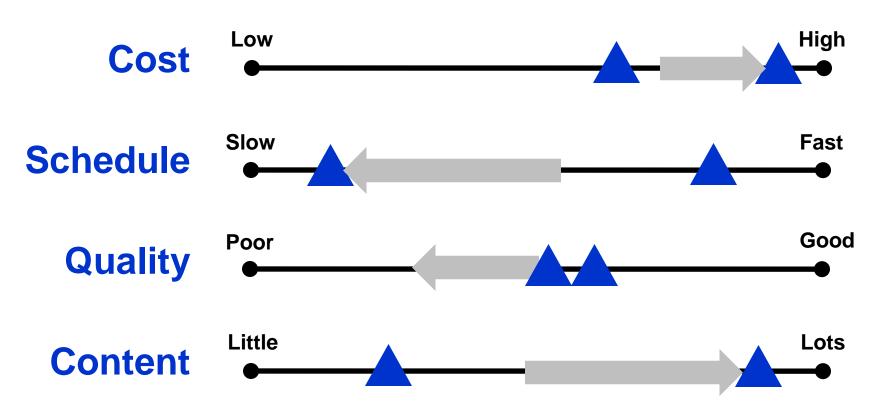
When we establish performance improvement goals and then execute plan to achieve those goals, we need to know which measures to collect, analyze and use for different performance vectors.

| Project Performance  | Product Performance   | Process Performance   |
|--|---|---|
| Cost (CPI) Schedule Earned Value Cycle time Scope management | Quality Functionality Maintainability (and MTBF) Safety Security Unit Product Cost Shelf-life | Efficiency Efficacy Billable: Overhead ratio (or Direct: Indirect) Productivity Tailorability/Scalability |
|  | Market life   |   |



#### **Contextual Performance Measurement**

When we talk about performance, or report performance measures – cost, schedule, quality, or content – it is almost meaningless to talk about one performance dimension without addressing its relationship to the others.





## Establishing the Link Between Process and Performance<sub>1</sub>

We said earlier that simply documenting processes based on a model or standard is not "improvement." However, we can positively affect business performance dimensions such as throughput, efficiency, efficacy, and product quality if the following conditions are true:

- 1. Our process representations (defined processes and assets) enable efficient and effective process performance, and if
- 2. There is high-fidelity between the performed process and the defined process, and if
- 3. The affects of skill or technology changes on performance are negligible

## Establishing the Link Between Process and Performance<sub>1</sub>

| Process Improvement  | Expected Business Performance<br>Improvement  | Relationship  |
|--|---|---|
| Improve project risk management practices  | Projects perform within estimated budgets   | Effective risk management practices can mitigate the impact of risks that cause over-spending   |
| Define test procedures   | Reduce the number and density of defects in released products and subsequently increase customer satisfaction | Missed or incorrectly performed steps in testing causes product defects to go undetected  |
| Develop a standard for product requirements and use that standard to review requirements | Reduce the cost associated with rework in product design and development                                      | Design and development rework has been attributed to poor requirements  |
| Introduce standards for conducting meetings  | Reduce operating costs  | There is waste/loss cost associated with meetings that do not result in defined decisions, actions, or outputs                          |
| Implement an organization-wide lessons learned   | Reduce operating costs  | There is signficant waste/loss cost associated with individuals and teams relearning things that have been previously learned by others |



#### **Process and Performance Manifesto**

To better ensure process improvement results in business performance improvement:

- □ Either let go of or scrutinize your existing beliefs about the relationship between process improvement and business performance improvement.
- □ Don't tamper with the system ... know what to improve, know what to leave alone, and why in both situations.
- Improve what you intend to measure, and then measure that which you improve.
- Connect process improvement to performance improvement by defining the relationships between the two.
- Measure the effects of process improvement on business performance and, in doing so, learn how to be honest with yourself.



## **Process and Performance Improvement in Harmony**

Are CMMI maturity levels and performance improvement mutually exclusive?

You're going to spend hundreds of thousands of overhead (or millions) dollars achieving a maturity level anyway, so ...

Why not offset some of that cost by achieving savings through real process and performance improvement?

## You can have both!



# Naturalspi

#### **NSPI Clients**





















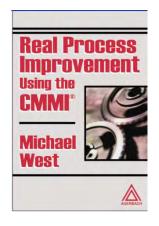






#### **Contacts and More Information**

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# High Maturity Heresy! Doing Level 5 Before Level 4 Without Data?

Thomas Lienhard
17 November 2010

# Where Do We Get Our High Maturity Knowledge?



#### The CMMI

- Upfront material
- •Infamous page 80

#### **Training Courses**

- CMMI Overview
- Understanding CMMI High Maturity Practices
- Six Sigma

Conferences

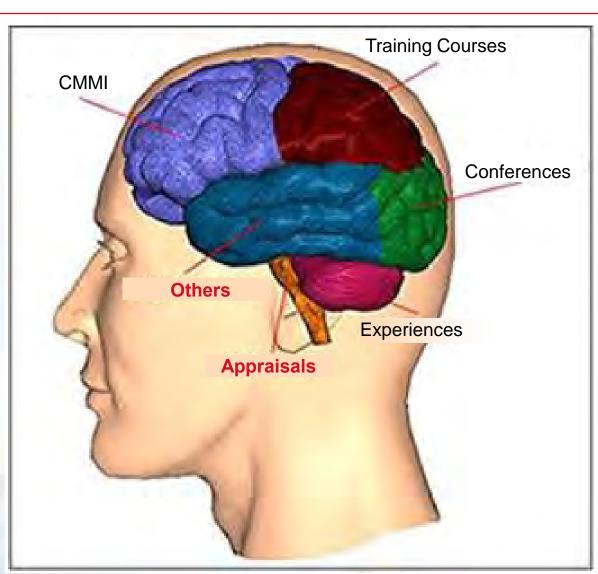
Experiences

#### **Appraisals**

- •Leads
- Mini Team partners

#### **Others**

- Consultants
- •"Experts"



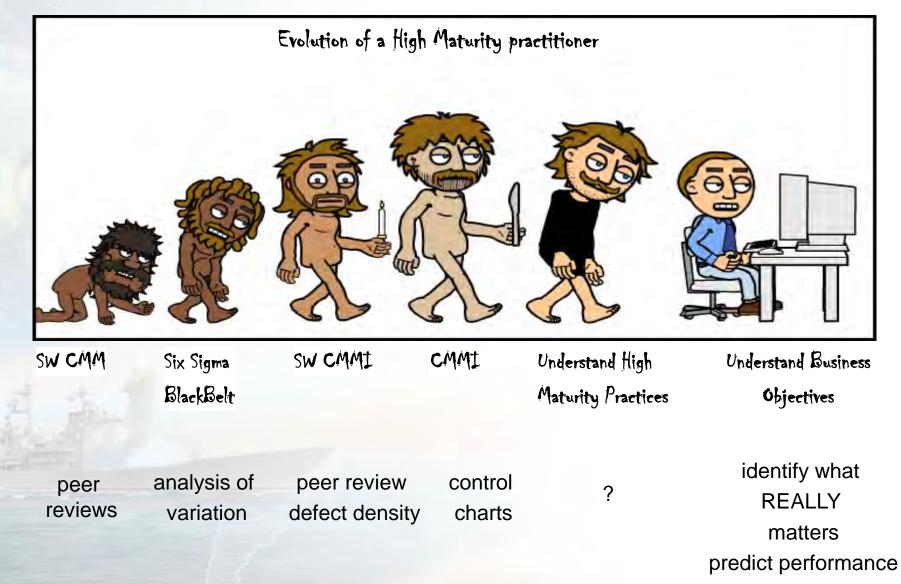
# Where Do We Get Our High Maturity Knowledge?





# [My] Evolution of High Maturity Understanding





11/18/2010

## Nirvana at Level 5?



- Achieved SW CMM Level 5 in 2001
- Did not see the "promised" 8:1 ROI
- What went wrong?
- Is it about finding an iterative process to collect data so SPC can be applied?
- Is it about hanging a sticker on the wall?
- Is it about appeasing the SEI to avoid an audit?
- Or is it about meeting your primary business objectives?
  - Needed to understand our business and business objectives
  - Needed to understand which processes had the greatest impact on business objectives



When you think you have it right, talk with those responsible for cost and schedule

# **Understanding What's Critical to Our Business**

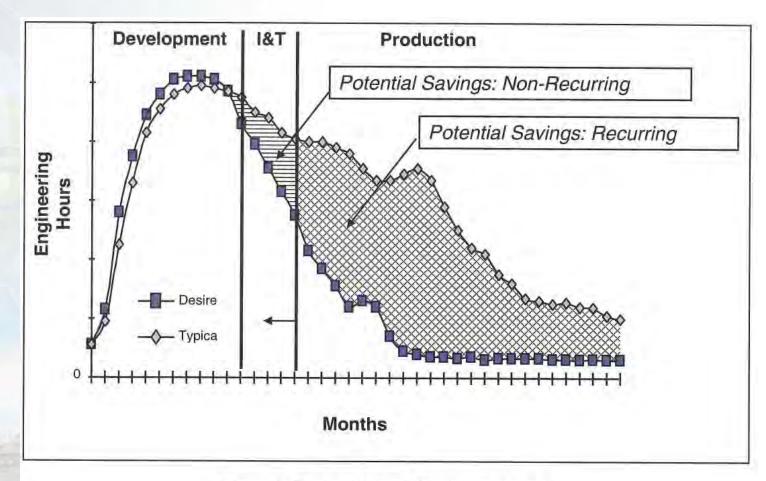


Figure 1. Typical Product Development Cycle

# **Changing Our Approach**



#### How to move from a Business that...



#### To a Business that



# **High Maturity Timeline**



Statistical techniques **SPC** 

**Pre-Concept** Manufacturing Development **Planning** Field 1950-1970s

1980s-Present **Org Objectives RMS** Models w

Balance performance with producibility and affordability

# **High Maturity Timeline**



Statistical techniques SPC

**Pre-Concept** 

**Planning** 

Development

Manufacturing

Field

ctives

1950-1970s



1980s-Pr

Would you ever implement QPM before you have a contract?

RMS Models Component Fielded System

Balance performance with producibility and affordability

# **High Maturity Timeline**



SPC

**Pre-Concept** 

Planning

Statistical techniques

Development

Manufacturing

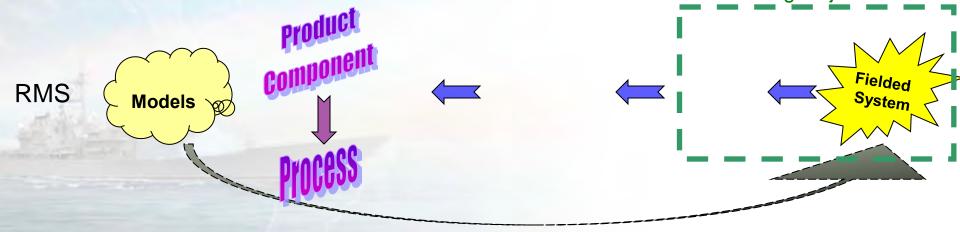
Field

1950-1970s



1980s-Pre

How can you be confident something can be built, if it has never been "invented"?



## **Brain Shift**



SW SE HWSE SW HWSE HW SW **SWSEHW** SyDe SystDeve System Development

# Remember, What is Critical to the Business



- Production over Development
  - Production is where cost and time are either minimized or super-inflated

The organization is willing to invest more in development in order to streamline production

- Production
  - Software
    - Hit control C
    - Rarely impacts development decisions
  - Hardware
    - Extremely complex
    - Very much impacts development decisions
- Primary focus is HW/SE/SW (System Development)
- The life cycle includes:
  - pre-concept
  - development
  - manufacturing
  - fielding













| Development<br>SW<br>SE |
|-------------------------|
|                         |





|                | Development |
|----------------|-------------|
| SW             |             |
| SW<br>SE<br>HW |             |
| HW             |             |
|                |             |
|                |             |
|                |             |
|                |             |





|    | Development |  |  |  |
|----|-------------|--|--|--|
| SW | 1st         |  |  |  |
| SE | SE 2nd      |  |  |  |
| HW | 2nd         |  |  |  |





| Pre-Concept |        | Develop | oment | Production | Field/Maint |
|-------------|--------|---------|-------|------------|-------------|
|             | SWSEHW |         |       |            |             |

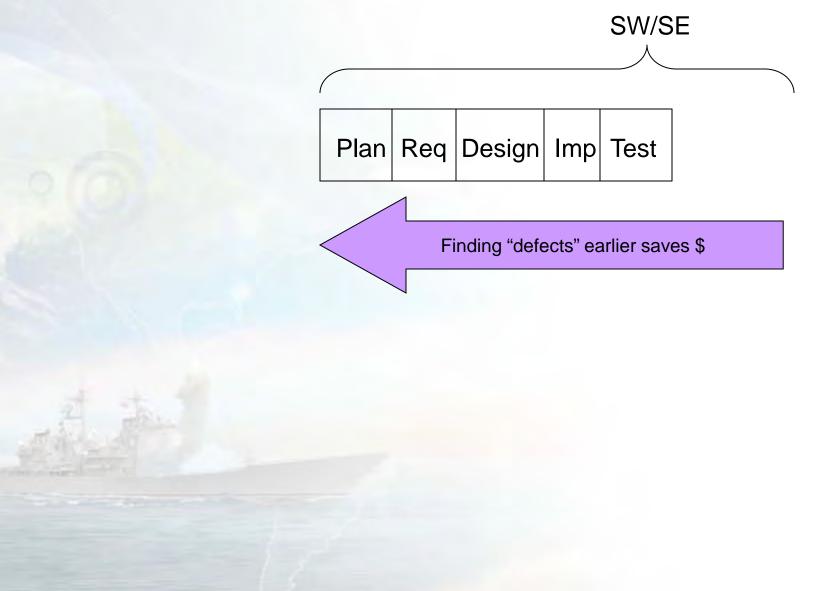




| Pre-Concept |        | Development | Production | Field/Maint |
|-------------|--------|-------------|------------|-------------|
| 1st         | SWSEHW | 2nd         | 1st        | 1st         |

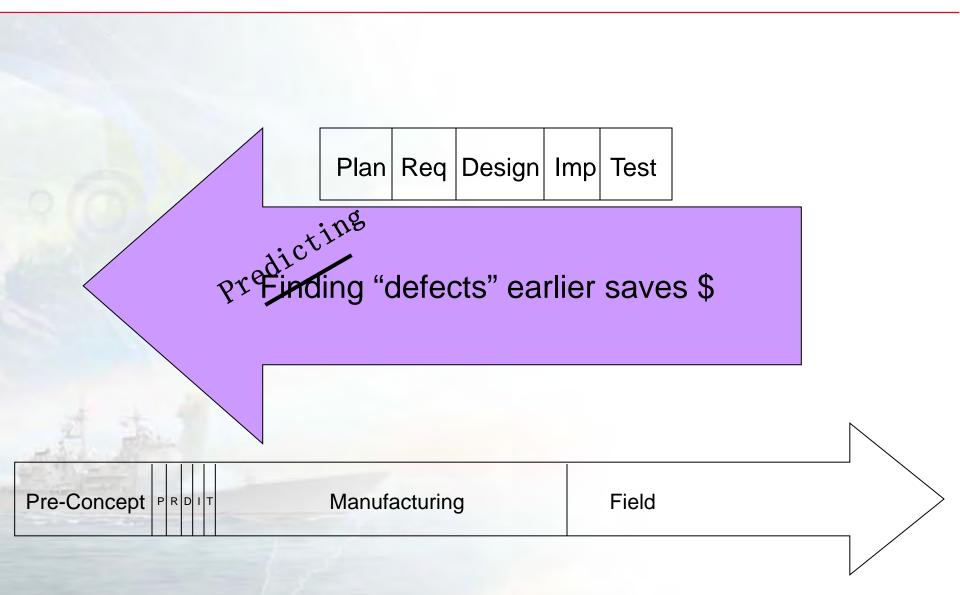






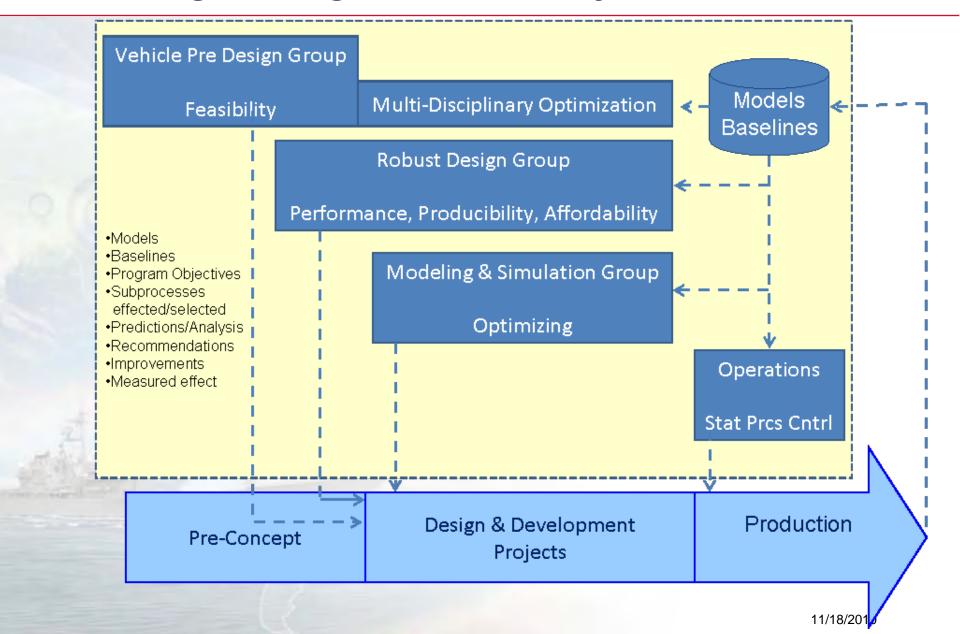
# **High Maturity "Epiphany"**







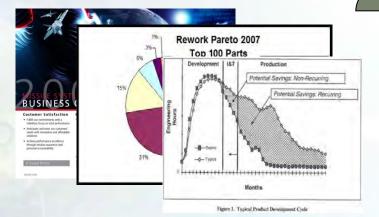
# **Modeling Throughout the Lifecycle**



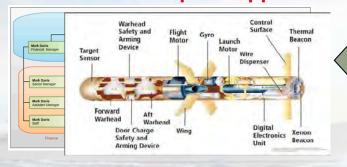
# **Breaking the Paradigm – Level 5 Before 4 Without "Data"**



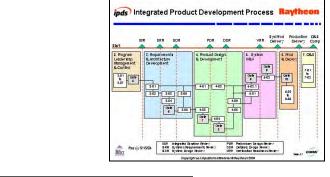
Start with business goals and drivers

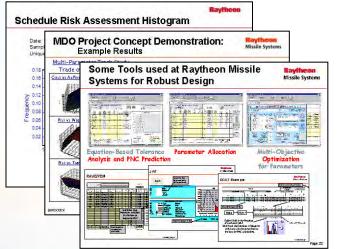


Take a product centric, multi-discipline approach



Establish objectives for entire lifecycle (pre-concept through delivery)





Predict success prior to design



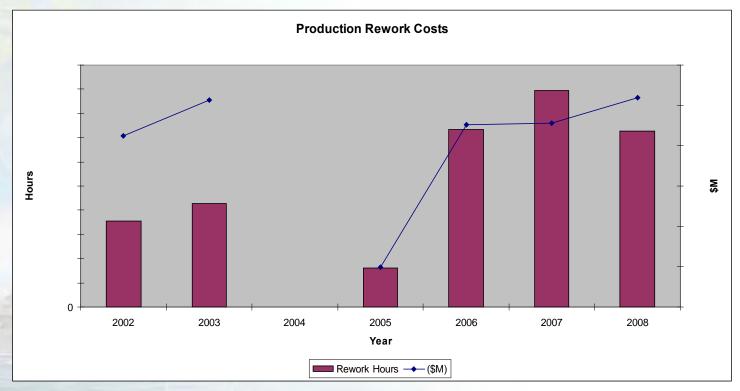


# **Business Objective – Increase Margin Profit**



## Cost of Poor Quality is Too High

- Cost and schedule need to be reduced
- Rework, scrap and support costs need to be reduced

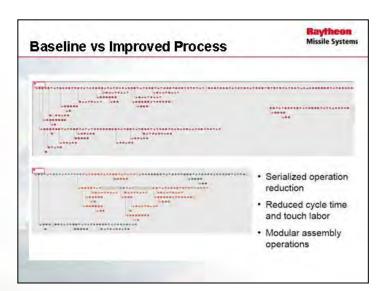


Improving production yields greatly reduces costs, schedule, rework, and scrap



# **Case Study**

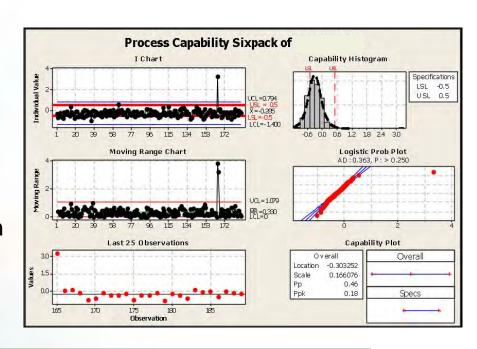
- Multiple projects using a common seeker have an Average Unit Production Cost (AUPC) objective
- Sensitivity analysis showed which subprocess was the significant cost driver
- EOSPA predictive cost model was created to characterize the process performance based on organizational historical baseline data
- Prediction showed the current process was incapable of achieving the AUPC objective
- Causal analysis was done
- Process was characterized:
  - Process steps
  - Touch points/hours
  - Parts
  - Effort
- Improvements were identified and implemented
  - Eliminated non-value added process steps
  - Reduced number of touch points and touch hours
  - Reduced cycle time and touch labor
  - Eliminated parts
  - Substituted processes with new processes which had reduced touch points/hours





### **Predictive Analysis**

- Probability of Noncompliance (PNC): Probability of exceeding either lower or upper specification limits
- Distribution fitted PNC = 30%
- Predicted estimated cost of scrap: \$XXM Annually
- Predictive Analysis Revealed:
  - Out of Control conditions will occur
  - Out of Spec conditions will occur
  - Mean was too close to lower limit -
    - need to center the distribution
  - Variance was too large
    - identify / reduce sources of variation



Low yields predicted as a result of poor process capability 180 out of 600 units would be scrapped



#### Results

- Resulted in 59% fewer process steps
- 45% fewer parts
- 44% less time
- 78% improved throughput
- Predicted yields increased to over 90%
- Predicted rework reduced by over 50%
- Predicted scrap reduced by over 40%
- Initial inspection costs reduced by over 50%
- Warranty costs expected to be reduced by over 25%



Tech support? My predictive analysis is giving the wrong answer again – can you please fix it?

# **Summary**

- To meet business objectives, engineering must be more predictable
  - Need to characterize process and product performance prior to implementation
  - Need to establish and track design metrics that relate to business objectives (production yield and cost)
  - MUST balance affordability and producibility as well as technical performance

# **Questions**





Contact:

Thomas\_G\_Lienhard@Raytheon.com





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### **Agenda**

- Overview
- Why CMMI® Maturity Level 5?
- Quality and Process Performance Objectives
- Raytheon Integrated Defense Systems Return on Investment
- Summary

#### **Overview**

# Why Maturity Level 5?

Where's the benefit?





My customer says I only have to be Maturity Level 3!

What is the impact of Maturity Level 5 on business goals?

#### This presentation will summarize:

- Why CMMI<sup>®</sup> Maturity Level 5 offers value to a business
- Benefits Raytheon Integrated Defense Systems has realized from deploying Maturity Level 5 processes





# **High Maturity Controversy**



Founding Fathers Debate High Maturity



Gansler Memo





#### The Race is On!

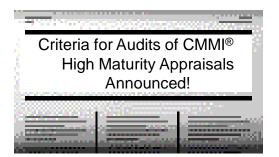


# "We have five maturity levels." We know three of them work."

Mark Schaeffer Office of the Under Secretary of Defense NDIA CMMI Technology Conference, 2007

#### Raytheon

#### Response!



Next up: High Maturity Misconceptions - Common Misinterpretations of CMMI® Maturity Levels 4 and 5!



And now...11
Frequently
Misinterpreted
ML 4-5 Practices!

SCAMPI<sup>SM</sup> High Maturity Lead Appraiser Certification Announced!









# Why CMMI® Maturity Level 5?

- CMMI® was created to support business improvement
  - CMMI® is a means to an end, not an end unto itself
  - As a model containing best practices, CMMI<sup>®</sup> is a business strategy tool to help achieve business objectives
- Business objectives often differ based on an organization's level of maturity
  - ML 2 and ML3 are about avoiding disasters and gaining control
    - ML 2 organization objectives: avoid disasters due to unrealistic plans, lack of requirements management, poor CM, management without progress measures, etc.
      - □ Example: begin measuring individual project productivity
    - ML 3 organization objectives: increased consistency of performance, common organizational process tailored by all projects, proactive project management
      - ☐ Example: collect productivity on all projects using a tailored common process
  - ML 4 and ML 5 are about managing against quality and process performance objectives to improve performance capability
    - ML 4 and ML 5 organization objective: quantitatively manage ability to perform against quality and process performance objectives that align with business objectives, take action accordingly, and perform causal analysis to improve performance
      - □ Example: understand variation in productivity, quantify ability to perform against productivity objective, target corrective action to improve productivity at project and organizational levels

# CMMI® Maturity Level 3 vs. Level 5

### Maturity Level 3

PMC SG1: Actual performance and progress of the project are monitored against the project plan.

IPM SP 1.5: Manage the project using the project plan, the other plans that affect the project, and the project's defined process.

OPF SG1: Identify improvements to the organization's process and process assets.



CMMI® ROI Scale

#### Maturity Level 5

OPP SP 1.3 Establish and maintain *quantitative* objectives for quality and process performance for the organization.

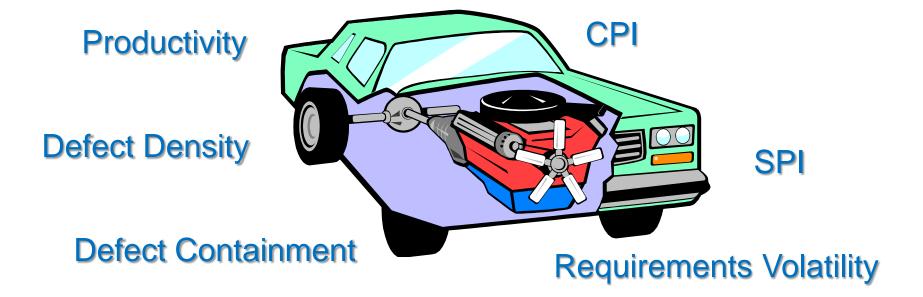
QPM SG1: The project is quantitatively managed using *quality and process* performance objectives.

OID SG1: Process and technology improvements, which contribute to meeting quality and process performance objectives, are selected.

# **Quality and Process Performance Objectives**

The engine that drives project performance

The engine that drives business performance



The engine that drives high maturity

#### Raytheon

# IDS Quality & Process Performance Objectives

#### **Raytheon Goals**

Be regarded as a customer focused company.

Grow revenue faster than market. Build on good performance in improving cash flow. Execute well and with predictability. Retain and attract world-class talent while providing superior opportunities for employee development. Treat all employees with respect. Leverage our diversity efforts as a competitive advantage, continuing Raytheon's leadership in diversity.

Improve ROIC for Raytheon Company. Take R6o<sup>™</sup> to the next level, further engaging customer and partners. Deliver greater value and predictability through IPDS, EVMS, and CMMI®.

#### Raytheon Integrated Defense Systems (IDS) Goals

#### Raytheon IDS Engineering Quality and Process Performance Objectives

| _  |   |   | _                                     |
|--|---|---|---------------------------------------|
| Cost   | Schedule  | Quality   | People                                |
| CPI ≥ X Productivity X% > Bid Defect Containment ≥ X% Requirements Volatility ≤ X% | SPI ≥ X Productivity X% > Bid On-time Deliverables Average > X% | Defect Containment ≥ X% Defect Density < X Requirements Volatility ≤ X% | Average X Hours Training per Employee |



Raytheon IDS
Return on Investment
from Implementing
CMMI® Maturity Level 5

# **Assumptions - 1**

- Data used in this study compared IDS 2005 performance 2005 2008
  - IDS achieved ML 3 for SE/SW in 2003, ML 4 for SE/SW & ML 3 for HW in 2005, and ML 5 for SE/SW/HW in 2008

#### Actuals and Estimates

- In most cases, actual data was used in this study. If actuals were not available, conservative estimates were used with rationale
  - Projecting future return from CAR/OID projects is generally estimated

#### Defining "Investment"

- The cost of all activities to incorporate maturity level 4 & 5 practices into our business processes and be appraised
  - Appraisal costs, development and deployment of updated processes and enablers (e.g., process performance models), and training

#### Calculating "Savings"

- Apply baseline rates (e.g., 2005 productivity) against 2008 size (e.g., lines of code) to calculate "projected cost at baseline rates"
  - Projected cost at baseline rates = "2005 productivity" \* "2008 size" \* "2008 labor rate"
- Compare "projected cost at baseline rates" to 2008 actuals
  - Savings = "projected cost at baseline rates" 2008 actuals



#### **CAR/OID**

- Sample included 19 CAR/OID process improvement projects
  - 14 CAR, 5 OID

|                         | Total ROI | Highest ROI | Lowest ROI | Median ROI | Number of data points |
|-------------------------|-----------|-------------|------------|------------|-----------------------|
| ROI on CAR/OID projects | 38.4 : 1  | 183.3 : 1   | 1.9 : 1    | 14.3 : 1   | 19                    |
| ROI on OID projects     | 57.1 : 1  | 183.3 : 1   | 10.7 : 1   | 50.8 : 1   | 5                     |
| ROI on CAR projects     | 25.8 : 1  | 85.5 : 1    | 1.9 : 1    | 9.6 : 1    | 14                    |

- The large ROI on CAR/OID projects is not surprising
  - CAR/OID projects focus on IDS Engineering goals
  - 7 Defect Containment, 10 Productivity, 1 CPI, 1 Measurement Team Training
- OID ROI is much higher than CAR projects
  - Benefits seen across programs provides more ROI

Applying CAR project improvements wider across the enterprise would result in more savings



# **Systems Engineering**

- Requirements Volatility
  - 56.1% improvement
- Requirements Development Productivity
  - 14.3 % improvement
- CPI
  - 4% improvement
  - CPI variance reduction of 63%



# **Software Engineering**

- DCTI Productivity
  - 65% improvement
- Defect Containment (SW Design through SW Maintenance)
  - 11.6% improvement

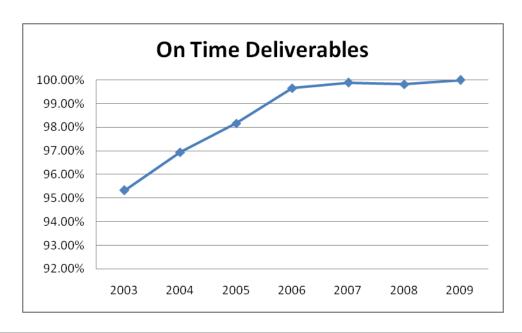


# **Hardware Engineering**

- Mechanical Engineering Productivity
  - 25 % improvement
- Electrical Design Productivity
  - Analog: 33% improvement
  - Digital: 56% improvement
- Defect Density for Drawing Checking
  - 65% improvement



#### On Time Deliverables



| Year | 2003   | 2004   | 2005   | 2006   | 2007   | 2008   | 2009    |
|------|--------|--------|--------|--------|--------|--------|---------|
| OTD  | 95.32% | 96.94% | 98.17% | 99.66% | 99.89% | 99.82% | 100.00% |

Through May

On Time Deliverables increase 4.9% since 2003. On Time Deliverables > 99% since 2006.



#### **Return on Investment**

#### Quantified ROI from IDS CMMI® Maturity Level 5 activity: 24:1

■ Comparison with industry – from "Performance Results of CMMI® -Based Process Improvement", August 2006, CMU/SEI-2006-TR-004

■ Median ROI 4:1

■ Lowest ROI 1.7:1

Raytheon IDS 24:1

■ Highest ROI 27.7:1



- IDS results are a direct consequence of meaningful process improvement aligned with the business and engineering objectives
  - Focus on major savings items: productivity, defect containment, CPI/SPI produces real results the essence of Level 5!

### **Summary**

- What an organization gets out of process deployment and CMMI ® appraisals is a reflection of what the organization puts into it
  - Organizations that focus on a maturity level number and "minimal compliance" are unlikely to derive any benefits
- High maturity, with its focus on quality and process performance objectives, puts organizations and projects in a position to succeed
  - OPP applies statistics to management
    - Establish quality and process performance objectives
    - Process performance models that illuminate potential problems in achieving objectives and address real project issues are invaluable to the organization
    - Process performance baselines identify the ability of the organization and its programs to perform in relation to their objectives
  - QPM and CAR push organizational objectives into projects' daily activities
    - Makes the objectives real to projects, and not just rhetoric
    - Helps projects more fully understand their role in business success
    - Having organizational/project goals in project metrics charts focuses project reaction when objectives are not being
  - OID prioritizes process improvements based on their relationship to objectives

# **Summary (continued)**

#### All Maturity Levels offer benefits

- Maturity Levels 2 and 3 help prevent disasters and gain control
  - Are not focused on quality and process performance objectives as a the driver of process improvement activity
  - Set a low ceiling on benefits of CMMI® based process improvement
- Maturity Levels 4 and 5 manage ability to perform against quality and process performance objectives that align with business objectives, and take action accordingly

A high maturity organization where all individuals recognize their role and responsibility for business success is an organization that is more likely to achieve success.



# **Questions**





#### **Contact Information**

■ For future questions the presenter contact information is:

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Raytheon Integrated Defense Systems

Tewksbury, MA 01876



### **Presenter Biography**

- Michael Campo is a Principal Engineering Fellow at Raytheon Company, with 32 years experience that includes roles as a software developer, software/system integrator, manager, software project manager, and process group leader. As process group leader for Raytheon Integrated Defense Systems, Mike developed and deployed processes that led to achievement of CMMI Maturity Level 3 in 2003, Maturity Level 4 in 2005, and Maturity Level 5 in 2008.
- Mike's present position is IDS Process Technical Director. He is a certified CMMI Instructor. Mike is a member of the CMMI V1.3 Core Model Team, the CMMI V1.3 Training Team, the CMMI Configuration Control Board, and the NDIA CMMI Working Group.







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#### **Overview**

- Raytheon Integrated Defense Systems (IDS) introduced its 2<sup>nd</sup> Generation of Process Performance Models (2G PPMs) as part of its CMMI high maturity journey
  - First generation models were developed to address individual lifecycle phase-specific issues
    - Designing for Quality, CAIV, cost models
    - Relationship to business and project objectives often implicit
  - 2G PPMs are used to manage risks related to business and project objectives (cost, schedule, quality) throughout the project lifecycle
    - Relationship of models to goals is <u>explicit</u> and enabled by model-embedded mitigation strategies
    - Supports ongoing, project grass-roots effort to achieve business and project objectives
- As 2G PPMs began to proliferate, sociotechnical issues emerged
  - Variation of individual needs became apparent
  - PPM questions related to project context manifested themselves as a series of requests for additional models and features
  - Caused model development and deployment issues related to model "packaging"
- This presentation will review the use of "horizontal segmentation" as a strategy to support deployment of a "model family" that supports Raytheon business goals and model-user needs

# System Lifecycle Analysis Model (SLAM)



- Initial 2G Process Performance Model
- Models influence of requirements volatility and requirements / design overlap on software / hardware development cost performance
  - Enables project risk assessment & sensitivity analysis around the likelihood of achieving performance cost objectives, and the development / deployment of mitigation strategies.

#### SLAM Model Inputs

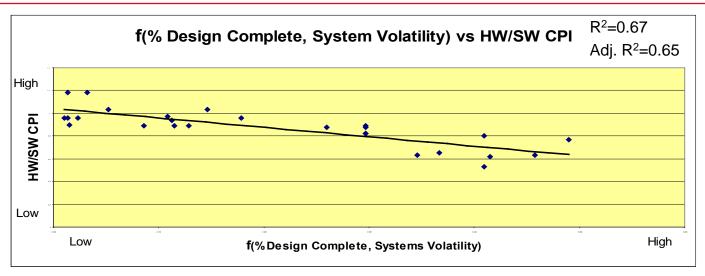
- Estimated % Design Complete at Systems Requirements Release
  - Confidence Range (+/- 5, 10, or 15%)
- Requirements Volatility Estimate
  - Best estimate based on historical baseline for product line, process tailoring, etc.
  - Variance estimates built into model based on historical actuals

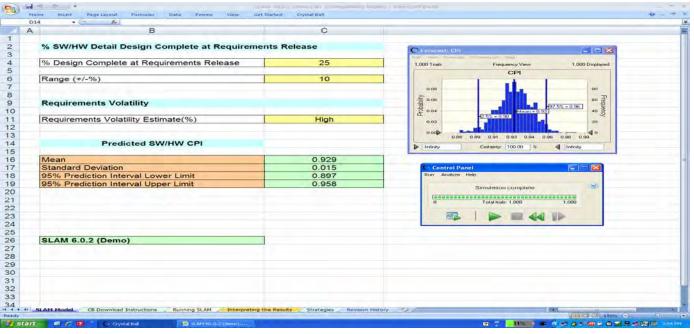
#### SLAM Model Outputs

- Projected Software / Hardware Cost Performance (CPI)
  - Mean, Standard Deviation
  - 95% Upper & Lower Prediction Interval Limits

# System Lifecycle Analysis Model (SLAM)



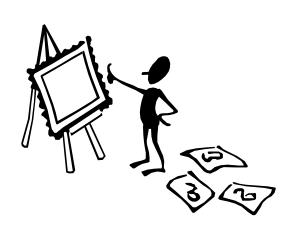






#### **Post-SLAM**

- Feedback from the SLAM deployment included requests for additional features
  - Can we predict requirements volatility?
  - Can we predict rework?
  - Can we predict IVV performance?
  - Can we predict likelihood of meeting schedule?
- The Process Performance Models Team began considering how to meet the needs of different users
  - Build additional features into SLAM?
  - Create separate models?
  - Bundle separate models into one supermodel?
- Decision made to create a schedule risk model
  - Used a SLAM-derived, similar look and feel approach
  - Provided an opportunity for further feedback



# Scheduling Analysis of Variability Engine (SAVE)



- Can we predict likelihood of meeting schedule?
- Models influence of individual task cycle time variation on our ability to deliver on-time against defined scheduling requirements
  - Enables projects to statistically quantify risk associated in meeting schedule and perform sensitivity analysis
  - Enables project identification of process changes that reduce risk (model contains potential mitigation strategies)
  - May be used during planning, re-planning, Estimate at Complete (EAC) activity

#### SAVE Model Inputs

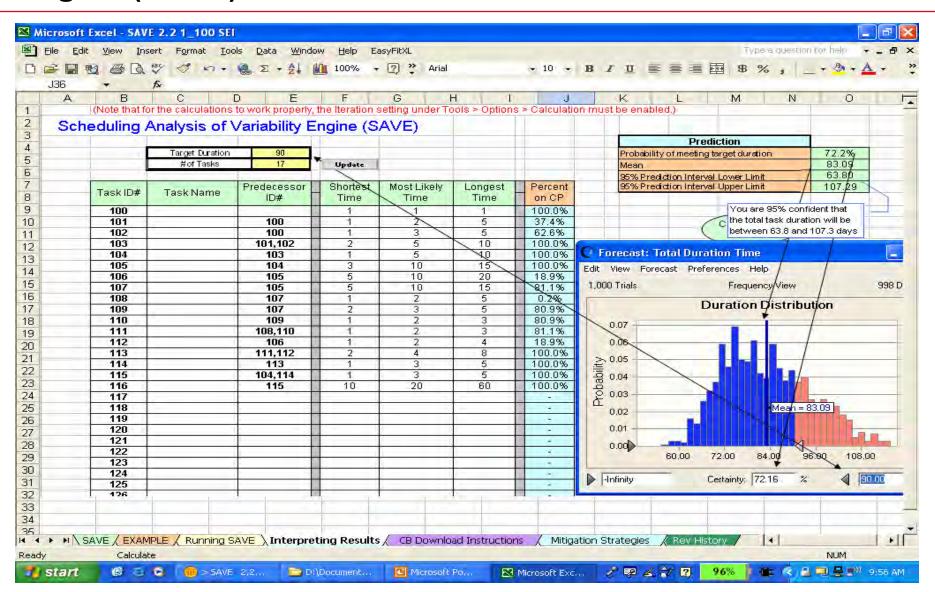
- Estimated individual task activity duration (typically defined in terms of their shortest, most likely and longest cycle time expectations)
- Individual task activity predecessors (defines which tasks feed which tasks)
- Target overall schedule duration (deadline)
- Number of task activities

#### SAVE Model Outputs

- Probability of meeting target duration
- Average Duration (Cycle Time)
- 95% Upper & Lower Prediction Intervals
- % of time each task is on the critical path

# Scheduling Analysis of Variability Engine (SAVE)

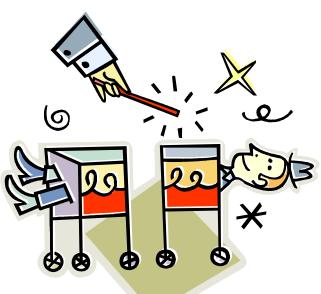






### **Post-SAVE**

- Feedback from the SAVE deployment included requests for further model refinements
  - Can we model probability of achieving cost targets?
  - Can we interface SAVE with Microsoft Project?
  - Can we integrate cost and schedule probability models?
  - Can we go below cost and schedule, and model size and productivity?
- The answer to all the questions is "yes", but returns us to the model/supermodel dilemma
- Solution: Horizontal Segmentation





### **Horizontal Segmentation**

- In 1986, Psychophysicist Dr. Howard Moskowitz was hired by Campbell's Soup Company to increase market share of Prego spaghetti sauce over archrival Ragu.
  - Prego sales lagged and Campbell's wanted to change the sauce and improve its consumer appeal
  - Through earlier work in the 1970s with Pepsi and Vlasic Pickles, Moskowitz had suspected that a universal "one sauce fits all" solution was not the answer
  - The answer instead was in the understanding and leveraging of variability
  - Moskowitz had 45 different sauces created and taste-tested
    - Results indicated that consumers had different concepts of the perfect spaghetti sauce that could be segmented into groups
    - Main preferences: plain, spicy, extra chunky
    - No extra chunky sauce was marketed at the time
    - Campbell's made \$600M over the next 10 years on extra chunky
  - Moskowitz' breakthrough approach, known as Horizontal Segmentation, revolutionized the spaghetti sauce, soft drink and multiple other consumer markets





### **Horizontal Segmentation**

### Horizontal Segmentation – groups people by preference patterns

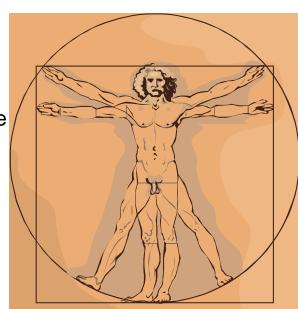
Contrasts with more traditional social stratifications (age, income, gender, race, etc.)

### Lessons of Horizontal Segmentation

- There is no perfect sauce. There are perfect sauces.
- There is no perfect pickle. There are perfect pickles.
- There is no perfect process performance model. There are perfect process performance models.

### Creating a suite of process performance models tailored to meet user preferences can facilitate deployment

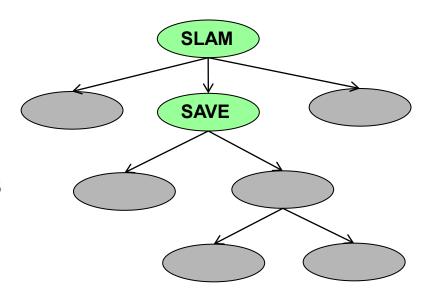
- Offering users multiple model options empowers users
- Enables model selection based on innate primal sensibilities (freedom of choice, personal preferences, contextual project differences)





### **PPM Horizontal Segmentation**

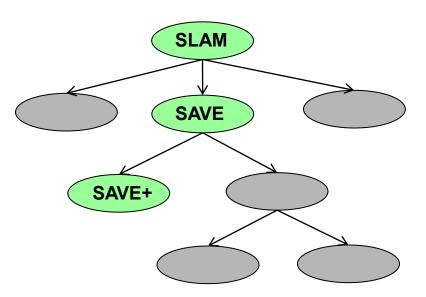
- Users of process performance models want options that support personal or project preferences
  - Combinations of cost, schedule, quality, integrated with other project tools
- Based on feedback and the concept of Horizontal Segmentation, Raytheon IDS has created a cost & schedule model suite derived from SLAM and SAVE
  - Supports business goals
  - Address individual project objectives, risks, and preferences



## **Raytheon**Integrated Defense Systems

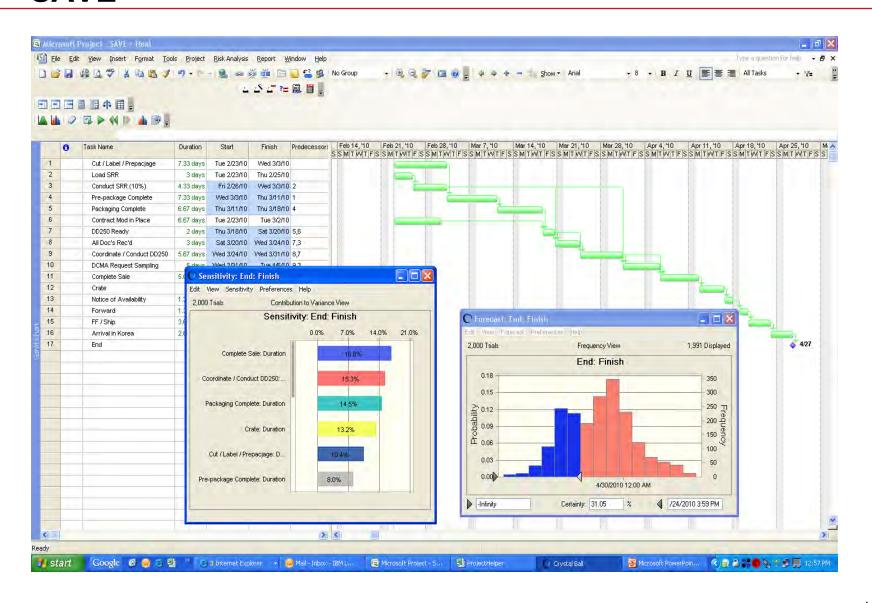
### **SAVE+**

- Can we integrate SAVE with Microsoft Project?
  - Uses a Crystal Ball interface to MS Project
  - Similar to Risk+





### **SAVE+**





### **Predictive Cost Modeling (PCM)**

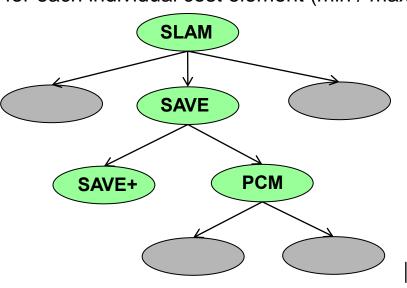
- Can we model probability of achieving cost targets?
- PCM models the influence of individual cost element variation on our ability to meet cost targets / budget requirements
  - Enables projects to statistically quantify risk associated in meeting cost targets / budgets and perform sensitivity analysis
  - Enables project identification of process changes that reduce risk
  - May be used during planning, re-planning, EAC activity

### Predictive Cost Model Inputs

- Estimated mean cost for each individual cost element
- Associated expected range of performance for each individual cost element (min / max for the default triangular distribution)
- Overall cost target

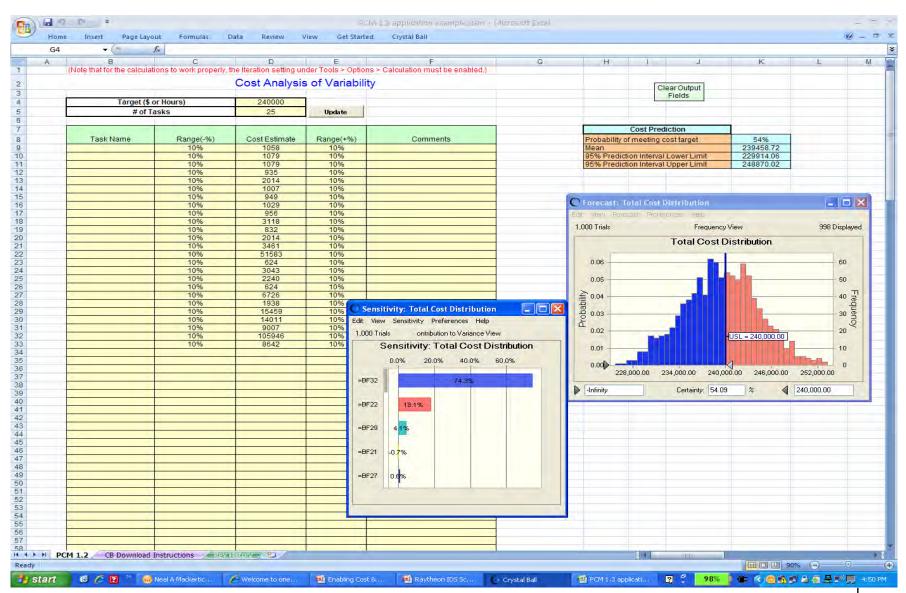
### Predictive Cost Model Outputs

- Predictive average cost
- 95% Upper & Lower Prediction Intervals
- Probability of meeting cost target / budgets
- Total cost estimate per task





### **Predictive Cost Modeling (PCM)**



# Integrated Predictive Cost & Scheduling (IPCS)



- Can we integrate cost and schedule probability models?
- IPCS integrates the Schedule Analysis of Variability Engine (SAVE) and the Predictive Cost Model (PCM)
  - Enables projects to statistically quantify risk associated in meeting cost & schedule targets and perform integrated sensitivity analysis
  - Enables project identification of process changes that reduce risk
  - May be used during planning, re-planning, EAC activity

### IPCS Cost Model Inputs

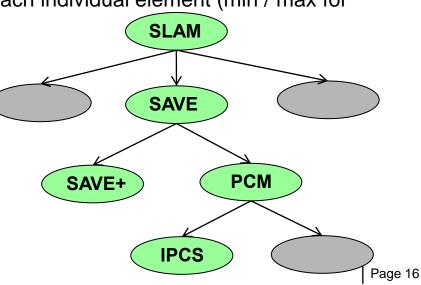
- Estimated mean cost and duration expectations for each individual element
- Individual task activity predecessors (defines which tasks feed which tasks)

 Associated expected range of performance for each individual element (min / max for the default triangular distribution)

Overall cost & schedule targets

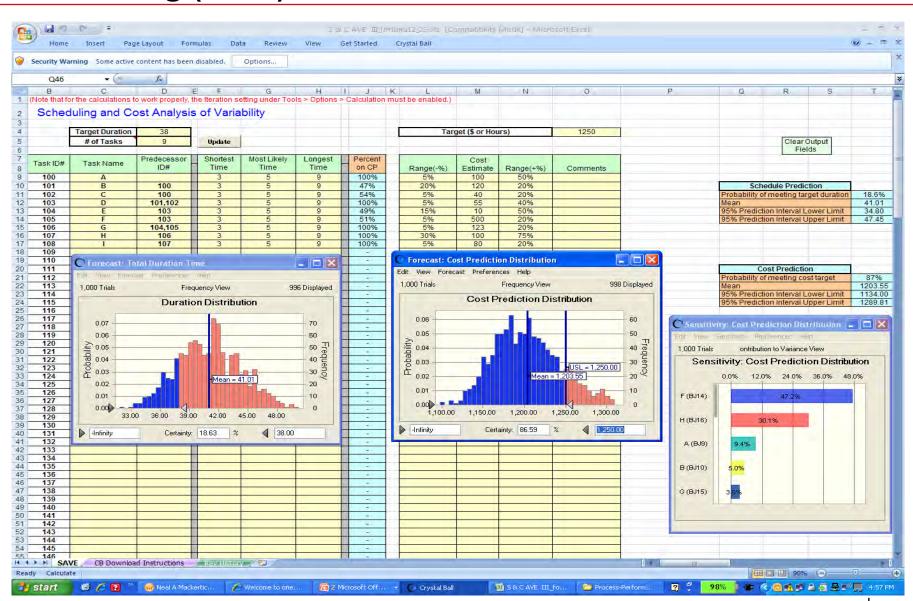
### IPCS Cost Model Outputs

- Probability of meeting cost & schedule targets
- Predictive mean expectation for cost & schedule
- 95% Upper & Lower Prediction Intervals
- % of time each task is on the critical path
- Total cost estimate per task



# Integrated Predictive Cost & Scheduling (IPCS)





# Effort based on Size & Productivity (ESP)



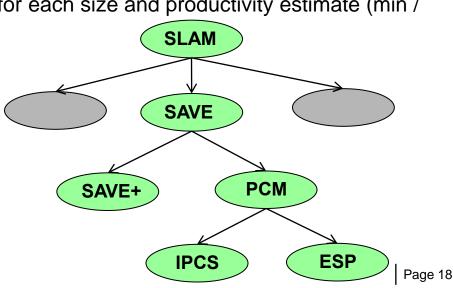
- Can we go below cost and schedule, and model size and productivity?
- ESP models the influence of size and productivity variability on our ability to meet cost targets / budget requirements
  - Enables projects to statistically quantify risk associated in meeting cost targets / budgets and perform sensitivity analysis
  - Enables project identification of process changes that reduce risk
  - May be used during planning, re-planning, EAC activity

### Size and Productivity Cost Model Inputs

- Estimated mean size and productivity for each individual cost element
- Associated expected range of performance for each size and productivity estimate (min / max for default triangular distribution)
- Overall cost target

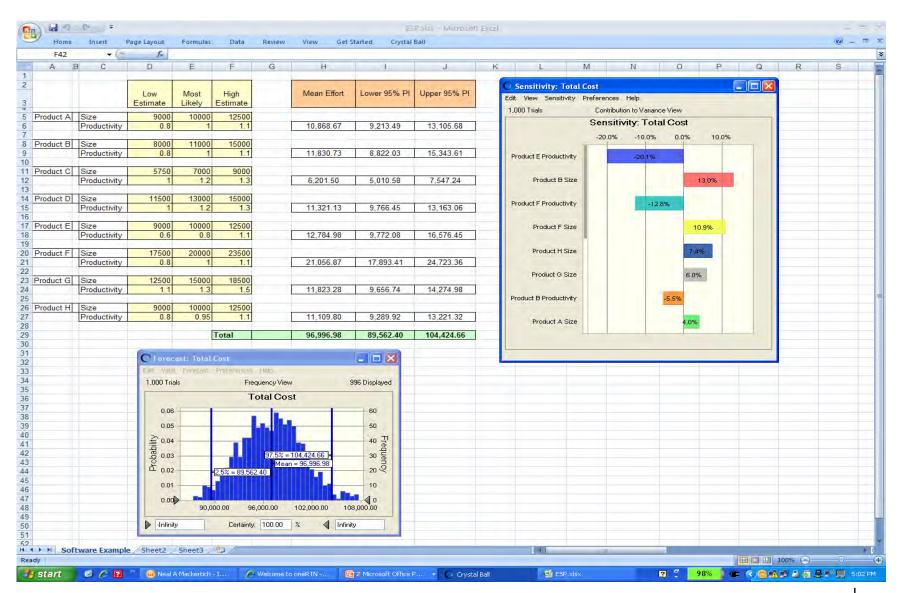
### Size and Productivity Outputs

- Predictive average cost
- 95% Upper & Lower Prediction Intervals
- Probability of meeting cost target / budgets
- Total cost estimate



# Effort based on Size & Productivity (ESP)







### **Results & Benefits**

- Stakeholder groups and projects have found the family of developed 2G PPMs both easy to use and conceptually aligned with project issues.
- Projects have identified and implemented specific improvements as a direct result of the integrated deployment of 2G PPMs that have enabled their execution. Resulting improvement efforts include:
  - Increased up-front investment in integrated Engineering planning & analysis
  - Process Performance trade studies
  - Process redesign
  - Enhanced peer reviews
  - Resource reallocation and conflict resolution
- In addition to deployed projects, 2G PPMs have been used up-front during the bid & proposal phase and are utilized by Engineering Management during schedule negotiations with program management.
- Significant qualitative benefits from integrated deployment of these models cannot be underestimated as projects leads / teams are clearly thinking and behaving differently with respect to their analysis of risk & opportunity.

### **Summary**

- Oddly enough, while project practitioners may tend to overestimate contextual differences (your model does not apply to me because my project is different!), analysts may tend to underestimate contextual differences and preferences in search of universal solutions that may or may not exist.
- Leveraging the concept of Horizontal Segmentation enables our development and deployment of Cost & Schedule Risk Analysis Models by
  - Sharpening our focus on understanding and serving our projects
  - Enabling our understanding of contextual differences between differing product types, project challenges and personal preferences
  - Increasing project team understanding of the benefits of statistical modeling and igniting their passion for more...
  - Reinforcing the need for data stratification
  - Challenging and reinventing our existing proposal / project management measurement & analysis processes and tools

"There is no perfect Process Performance Model. There are perfect Process Performance Models."



### References

- 1. Mackertich, Campo, Beitz, "System Lifecycle Analysis Model (SLAM)", 2<sup>nd</sup> SEI High Maturity Measurement and Analysis Workshop, November 2008.
- Mackertich, Campo, "Scheduling Analysis of Variability Engine(SAVE)", 3rd SEI
  High Maturity Measurement and Analysis Workshop, March 2009.
- 3. Campo, Mackertich, "Goal Question Model", NDIA CMMI Technology Conference and User Group, November 2009.
- 4. Malcolm Gladwell on spaghetti sauce, http://www.ted.com/talks/lang/eng/malcolm\_gladwell\_on\_spaghetti\_sauce.html



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Raytheon Integrated Defense Systems





### **CMMI®** for Executives

**NDIA Systems Engineering Division** 

in partnership with:

Software Engineering Institute
Carnegie Mellon University

November 2010

<sup>®</sup> CMMI is registered in the U.S. Patent and Trademark Office by Carnegie Mellon University

## **Topics**



### Do You Need CMMI?

What Is CMMI?
How Can CMMI Benefit You?
Who Is Using CMMI?

How Can You Get Best Value from CMMI?



### Do You Need CMMI?



### Recognize these symptoms?

- Missed commitments
  - Late delivery
  - Last minute crunches
  - Spiraling costs
- Inadequate management visibility
  - Too many surprises
- Quality problems
  - Too much rework
  - Functions not working correctly
  - Customer complaints
- Poor morale
  - Crisis atmosphere
  - High turnover
  - Low productivity

### Does the following occur?

- Poor planning
  - Plans not realistic or followed
  - Work is not tracked against the plan; plans are not adjusted.
- Baselines not controlled
  - Inconsistent requirements
  - Changes not managed
- Ineffective organizational structure
  - Functions not well integrated
  - Designs not producible
- Unable to repeat successes
  - Staff skills and knowledge not available when needed
  - Dependent on heroic individuals

## **CMMI Features Help Address Common Issues**



| CMMI Feature            | Description and Examples   |  |
|-------------------------|--|--|
| Results Oriented        | Industry best practices for project planning and execution                             |  |
|                         | Performance-driven measures for consistent outcomes                                    |  |
| Priorities Based on     | <ul> <li>Investments and maturity prioritized to align with business goals</li> </ul>  |  |
| Business Value          | <ul> <li>Appraisals relative to model to set direction ("map and compass")</li> </ul>  |  |
| <b>Customer Focus</b>   | Validation of customer needs across the project life cycle                             |  |
|                         | <ul> <li>Manage product/service quality (verification, validation, reviews)</li> </ul> |  |
| Proactive               | Forward-looking measurement, monitoring, risks, corrective action                      |  |
| Management              | <ul> <li>Management decisions based on plans, data, alternatives</li> </ul>            |  |
| Flexibility             | <ul> <li>Adaptable to a variety of businesses (domain, size, products)</li> </ul>      |  |
|                         | <ul> <li>Non-prescriptive (required, expected, informative components)</li> </ul>      |  |
| <b>Business Process</b> | Cross-functional stakeholder involvement   |  |
| Integration             | Coordinate various improvement strategies and methods                                  |  |
|                         | (Lean, Six Sigma, ISO, Agile, etc.)  |  |
| Continuous              | Standardized assets tailored for project characteristics                               |  |
| Learning                | Leverage experience and history across projects  |  |

## Why Focus on Process?



## The quality of a system is highly influenced by the quality of the process used to acquire, develop, and maintain it.

A long-standing premise in manufacturing

 Good processes increase the likelihood of successful projects

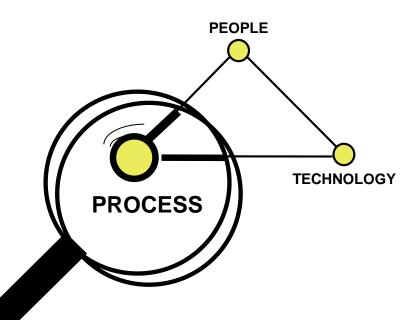
## Process can enhance the capabilities of your workforce

Work smarter, not just harder

 Leverage organizational experience and best practices

## Process integrates technology with resources

 Technology, by itself, will most likely not be used effectively



## **Topics**



Do You Need CMMI?

What Is CMMI?

How Can CMMI Benefit You?

Who Is Using CMMI?

How Can You Get Best Value from CMMI?



### What Is CMMI?



## CMMI is a model representing a collection of best practices proven effective in industry

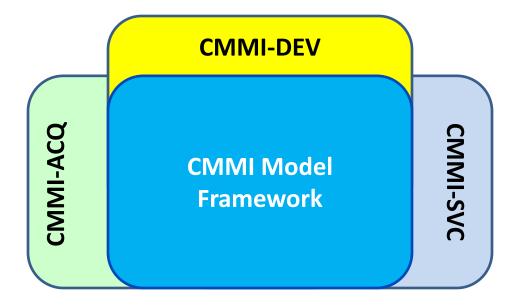
- A framework for developing, improving, and sustaining business performance
- Provides a process focus on work activities
- Developed by industry (commercial and defense), government, academia

### **CMMI** targets three primary environments:

- Development -Engineering a product or service
- Services –
   Providing services
- Acquisition –
   Acquiring products and services

## The CMMI product suite consists of:

- Models and primers
- Appraisal methods
- Training courses



Capability Maturity Model Integration (CMMI®)

### What CMMI Can Add to Your Organization



- Integration of business processes across functions based on industry best practices
- Visible project and organizational measures aligned with achievement of business objectives
- Commonly accepted process framework for inter-company coordination and competitor benchmarking
- Repeat project successes through standardization, tailoring, and capture of organizational process assets
- Avoid project performance issues through process discipline, proactive management, and early stakeholder engagement
- Predictable project performance, with fewer surprises

## **CMMI Model Overview**



| Process              | Clusters of related practices, in several categories                                 |  |  |
|----------------------|--|--|--|
| Areas                | •Project Management – planning, monitoring, suppliers, risk,                         |  |  |
|                      | •Support – CM, QA, measurement, decision analysis,                                   |  |  |
|                      | •Process Management – organizational processes, training,                            |  |  |
|                      | •Engineering – requirements, development, integration,                               |  |  |
|                      | •Services – development, delivery, transition,                                       |  |  |
|                      | •Acquisition – requirements, solicitation, agreements,                               |  |  |
| Generic              | neric Enable process management, deployment and improvement                          |  |  |
| Practices            | •Plans, monitoring, CM, stakeholders, objective evaluation,                          |  |  |
| Goals                | Describes characteristics for implemented processes                                  |  |  |
| Capability<br>Levels | Achievement of process improvement within an individual process area                 |  |  |
| Maturity<br>Levels   | Achievement of process improvement across a predefined set of process areas (stages) |  |  |

## **CMMI** Appraisals



Appraisals compare organization and project processes against CMMI models to determine improvement priorities Senior management's role in appraisals:

- Provide sponsorship and resources
- Set appraisal scope and objectives
- Ensure follow-through on appraisal findings and prioritized improvement actions

CMMI provides a family of appraisal methods, with varying intent, confidence levels, data collection, resources needed

- Flexible focus: approach, deployment, institutionalization
- Rigorous benchmark rating method (for maturity levels)
- "Quick look" diagnosis of process weaknesses

Licensed SEI partners deliver SCAMPI<sup>SM</sup> appraisal services

http://www.sei.cmu.edu/partners/directory/

Note that for internal process improvement, companydeveloped and other methods can be effective





## **Topics**



Do You Need CMMI?

What Is CMMI?

**How Can CMMI Benefit You?** 

Who Is Using CMMI?

How Can You Get Best Value from CMMI?



## Reasons You Should Adopt CMMI



#### 1. Increase customer satisfaction

- Deliver products and services that satisfy user needs
- Deliver products and services on time and within budget

#### 2. Increase probability of capturing new and repeat business

- Improved ability to meet commitments
- Reduces customer-perceived risk of award to your organization
- Can be a discriminator relative to your competition

### 3. Increase profit through improved quality and less rework

- Better predict actual costs through repeatable processes
- Better visibility into projects due to established measures and analysis techniques
- Significantly reduce the probability of problem programs
- Reduce costs by capitalizing on organizational infrastructure, processes, training, tools and early/often stakeholder involvement

#### 4. Increase productivity

- More efficiency through implementation of common processes, tools and training
- Improved productivity by implementing process improvement that are directly aligned key organizational goals and objectives.
- Higher employee morale and less turnover

### **Benefits of CMMI-Based Process Improvement**



## Many companies cite performance benefits from CMMI

 Published in conferences, articles, papers, studies, surveys, reports

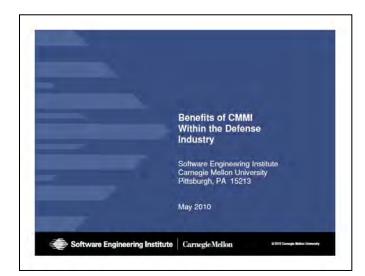
## **SEI collects quantitative measures of CMMI performance improvement**

- Technical reports, including:
  - "Performance Results of CMMI-Based Process Improvement" (<a href="http://www.sei.cmu.edu/pub/docume">http://www.sei.cmu.edu/pub/docume</a> <a href="http://obsreports/pdf/06tr004.pdf">nts/06.reports/pdf/06tr004.pdf</a>)

| Performance<br>Category                          | Median<br>Improvement |
|--|-----------------------|
| Cost   | 34%                   |
| Schedule   | 50%                   |
| Productivity                                     | 61%                   |
| Quality  | 48%                   |
| Customer<br>Satisfaction                         | 14%                   |
| ROI  | 4.0 : 1               |
| CMU/SEI-2006-TR-004. Data from 35 organizations. |                       |

## **Industry Benefits from CMMI**





| Example measures reported by NDIA member companies: |   |  |  |  |
|---|---|--|--|--|
| Defect repair effort                                | <ul> <li>Defect repair hours: -58% (ML3 to ML5)</li> <li>Defect cost savings: -105 hrs per defect</li> <li>I&amp;T hrs/defect: -24%</li> <li>Hours/KLOC: -22% (ML3 to ML5)</li> </ul> |  |  |  |
| Defect density                                      | •62% fewer high-severity defects (ML5) •Defect phase containment: +240% (ML5) •>85% defects removed prior to sys test •Acceptance test: < 0.15 defects/KLOC                           |  |  |  |
| Development cost                                    | •SW development cost: -28% (ML3 to ML5) •Potential project savings: \$1.9M—\$2.3M   |  |  |  |
| Productivity  | •Productivity gain: +42% (ML5, 9 yrs)   |  |  |  |
| Cost/schedule                                       | •Over 6X less likely cost/schedule impact   |  |  |  |

The new data presented in this report demonstrates that effective implementation of good practices aided by use of CMMI can improve cost, schedule, and quality performance.

Benefits of CMMI in the Defense Industry, Software Engineering Institute, May 2010. <a href="http://www.sei.cmu.edu/library/abstracts/presentations/CMMI-Benefits-to-Defense-Industry.cfm">http://www.sei.cmu.edu/library/abstracts/presentations/CMMI-Benefits-to-Defense-Industry.cfm</a>

## **Topics**



Do You Need CMMI?

What Is CMMI?

How Can CMMI Benefit You?

Who Is Using CMMI?

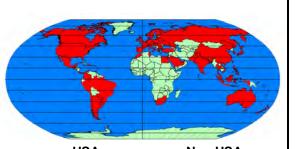
How Can You Get Best Value from CMMI?



### **CMMI** Adoption

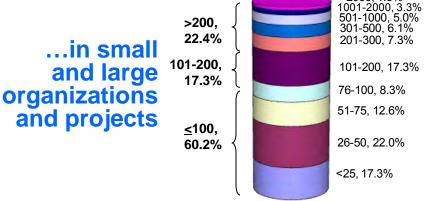


CMMI appraisals are conducted worldwide...



Commercial In-House Contractor for Military/Government Military/Government Agency

| USA |      | Non-USA |      |        |
|-----|------|---------|------|--------|
|     | Qty  | %       | Qty  | %      |
|     | 425  | 35.2%   | 3354 | 91.8%  |
|     | 651  | 54.0%   | 223  | 6.1%   |
| 1   | 130  | 10.8%   | 76   | 2.1%   |
|     | 1206 | 100.0%  | 3653 | 100.0% |



Organization Size (Employees) (4863 organizations reporting)

#### ...in a wide range of businesses

#### **Services (72.1%)**

- · Business Services
- Engineering and Management Services
- Health Services
- Other Services

#### **Manufacturing (15.7%)**

- Electronic and Electric Equipt
- Transportation Equipment
- · Instruments & Related Products
- Industrial Machinery
- · Other Mfg Industries

#### Other (12.2%)

- Finance, Insurance, Real Estate
- Public Administration/Defense
- Transportation, Communication, Utilities

Based on primary Standard Industrial Classification (SIC) codes reported in CMMI-based appraisals.

### ...at all levels of process maturity

|                              | Commercial<br>In-House | Contractor for Military/ | Military/<br>Government<br>Agency |
|------------------------------|------------------------|--------------------------|-----------------------------------|
| No Rating Given              | 5.3%                   | 8.0%                     | 22.3%                             |
| Initial (ML1)                | 0.6%                   | 1.4%                     | 1.0%                              |
| Managed (ML2)                | 25.8%                  | 31.5%                    | 45.6%                             |
| Defined (ML3)                | 58.1%                  | 49.3%                    | 26.7%                             |
| Quantitatively Managed (ML4) | 2.9%                   | 1.0%                     | 1.5%                              |
| Optimizing (ML5)             | 7.2%                   | 8.9%                     | 2.9%                              |
|                              | (3779 orgs)            | (874 oras)               | (206 orgs)                        |

Source: SEI Process Maturity Profile, Sept 2010.

http://www.sei.cmu.edu/cmmi/casestudies/profiles/cmmi.cfm

## **Topics**



Do You Need CMMI?

What Is CMMI?

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Who Is Using CMMI?

**How Can You Get Best Value from CMMI?** 



## Getting Value from CMMI Your Role as an Executive



## Set the vision and direction for CMMI-based improvement

- Establish measurable objectives
- Be a visible sponsor set expectations for involvement
- Manage process improvement like a project

### Provide resources and support

- Funding, staffing, tools
- Choose the best people to lead respected opinion leaders

### Keep it real

- Maintain relentless focus on business value and program performance
- Involve projects and practitioners for the best ideas
- Hold people accountable
- Track and communicate progress
- Recognize and reward achievement

### The Effective Use of CMMI®



## Summary of NDIA industry position statements for obtaining best value from CMMI investments\*:

- 1. Good processes increase the likelihood of achieving successful project performance
- **2. CMMI is a model, not a standard** adapt CMMI to your business environment, resources, and objectives
- 3. Focus on business improvement objectives a primary emphasis on achieving levels may not achieve significant benefits and may increase rather than decrease costs
- **4. High maturity is a business case** justify the investment; many organizations find business value in improving processes even at lower CMMI maturity levels
- 5. Maturity level ratings are not alone a predictor of project performance many other factors can be significant contributors
- **6. Don't specify maturity levels in acquisitions** use CMMI to probe supplier capability and process execution risks
- 7. Greatest benefits of appraisals are from improvements, not evidence or ratings disproportionate effort on appraisal preparation risk can diminish business returns

<sup>&</sup>quot;The Effective Use of CMMI®", NDIA Systems Engineering Division, June 2009. http://www.ndia.org/Divisions/Divisions/SystemsEngineering/Pages/CMMI Working Group.aspx

### Want to Learn More about CMMI?



### **SEI CMMI web pages:**

What is CMMI? Models Adoption

Conferences Performance Results Appraisals

FAQs Background Information Contacts



### CMMI focus topics, guidance, technical reports:

CMMI and Agile CMMI and Six Sigma Product Line Practices

CMMI in Small Settings CMMI in Acquisition Interpretive Guidance

Earned Value Management SW-Only Organizations Operations Organizations

### **Training:**

Process Improvement Introduction to CMMI Intermediate Concepts of CMMI CMMI Level 2-3 for Practitioners Understanding High Maturity SCAMPI Appraiser training

#### **User Networks**

SEI Partner Network Newsgroups, Blogs, Wikis Books, Periodicals, Articles Consultants Conferences Asset Repositories

#### **Questions? Comments?**

Web: http://www.sei.cmu.edu/cmmi Email: cmmi-comments@sei.cmu.edu

SEI Customer Relations: (412) 268-5800, <u>customer-relations@sei.cmu.edu</u>



## Get It Sold, Keep It Sold

Making the Business Case for High Maturity November 17, 2010

Richard L. W. Welch, PhD
Associate Technical Fellow
Robert M. Sabatino
Six Sigma Black Belt
Northrop Grumman Corporation

## Warm & Fuzzy Prospects . . .



# . . . may initially attract management's attention, but they will soon be asking, "What's in it for me?"

#### **CMMI** Performance Results Summary

| Performance<br>Category  | Median<br>Improvement | Number of Data<br>Points | Lowest<br>Improvement | Highest<br>Improvement |
|--------------------------|-----------------------|--------------------------|-----------------------|------------------------|
| Cost                     | 34%                   | 29                       | 3%                    | 87%                    |
| Schedule                 | 50%                   | 22                       | 2%                    | 95%                    |
| Productivity             | 61%                   | 20                       | 11%                   | 329%                   |
| Quality                  | 48%                   | 34                       | 2%                    | 132%                   |
| Customer<br>Satisfaction | 14%                   | 7                        | -4%                   | 55%                    |
| Return on Investment     | 4.0 : 1               | 22                       | 1.7:1                 | 27.7 ; 1               |

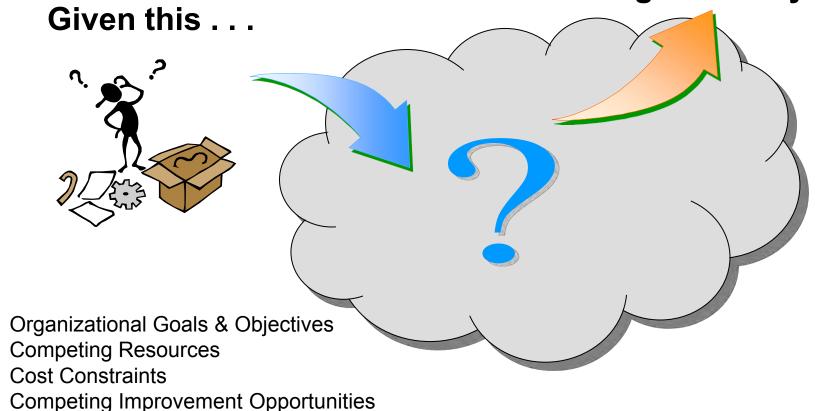
Note: The performance results in this table express change over varying periods of time.

Source: Gibson, Goldenson & Kost, "Performance Results of CMMI-Based Process Improvement," CMU/SEI-2006-TR-004, August, 2006.

## This Is Your Opportunity to Market!



# ... How do you make the business case for High Maturity

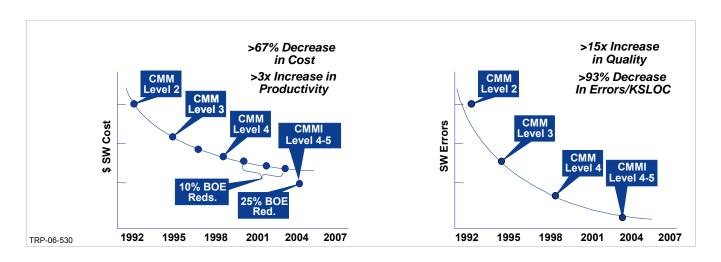


You Need a Structured Methodology to Market the Value

## Getting Past the Warm & Fuzzies



- Locate the opportunities
- Rank the candidates objectively
- Plan to execute successfully
- Capture & market the results
- Make it permanent



## Good Engineers Use Trade Studies



Use this...

... To make the business case for High Maturity

Given this . . .



| Color | Colo

Organizational Goals & Objectives

Competing Resources

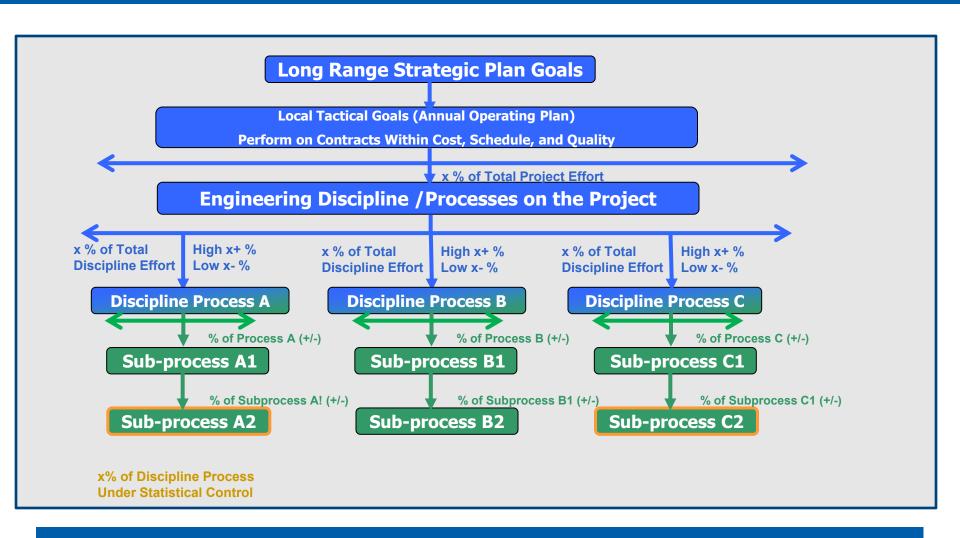
**Cost Constraints** 

**Competing Improvement Opportunities** 

Identify, Quantify & Prioritize Improvement Opportunities

## Align Business Goals with the Work

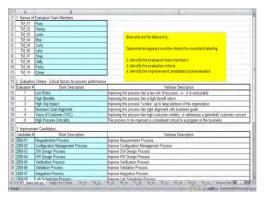




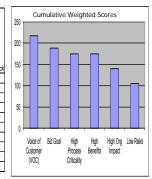
#### Locate the Opportunities

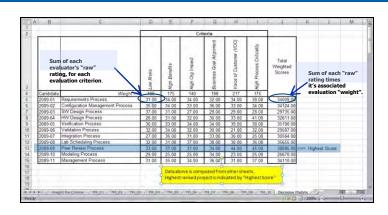
## Choose the Right Projects





|             |           |               | •               |                            |                            |                             | 1   |       |
|-------------|-----------|---------------|-----------------|----------------------------|----------------------------|-----------------------------|-----|-------|
|             |           | _             | Cri             | teria                      | _                          |                             |     |       |
| Evaluator   | Low Risks | High Benefits | High Org Impact | Business Goal<br>Alignment | Voice of<br>Customer (VOC) | High Process<br>Criticality | sum | check |
| Director 1  | 20        | 20            | 10              | 20                         | 20                         | 10                          | 100 | ok    |
| Director 2  | 10        | 10            | 20              | 10                         | 20                         | 30                          | 100 | ok    |
| Director 3  | 15        | 15            | 15              | 30                         | 10                         | 15                          | 100 | ok    |
| Director 4  | 10        | 15            | 10              | 15                         | 20                         | 30                          | 100 | ok    |
| Director 5  | 15        | 15            | 25              | 20                         | 25                         | 0                           | 100 | ok    |
| Director 6  | 5         | 15            | 20              | 23                         | 22                         | 15                          | 100 | ok    |
| Director 7  | 10        | 20            | 15              | 25                         | 15                         | 15                          | 100 | ok    |
| Director 8  | 5         | 15            | 10              | 20                         | 25                         | 25                          | 100 | ok    |
| Director 9  | 5         | 10            | 10              | 20                         | 30                         | 25                          | 100 | ok    |
| Director 10 | 10        | 40            | 5               | 5                          | 30                         | 10                          | 100 | ok    |
| Total       | 105       | 175           | 140             | 188                        | 217                        | 175                         |     |       |





Identify owning
Directors,
proposals and
evaluation criteria



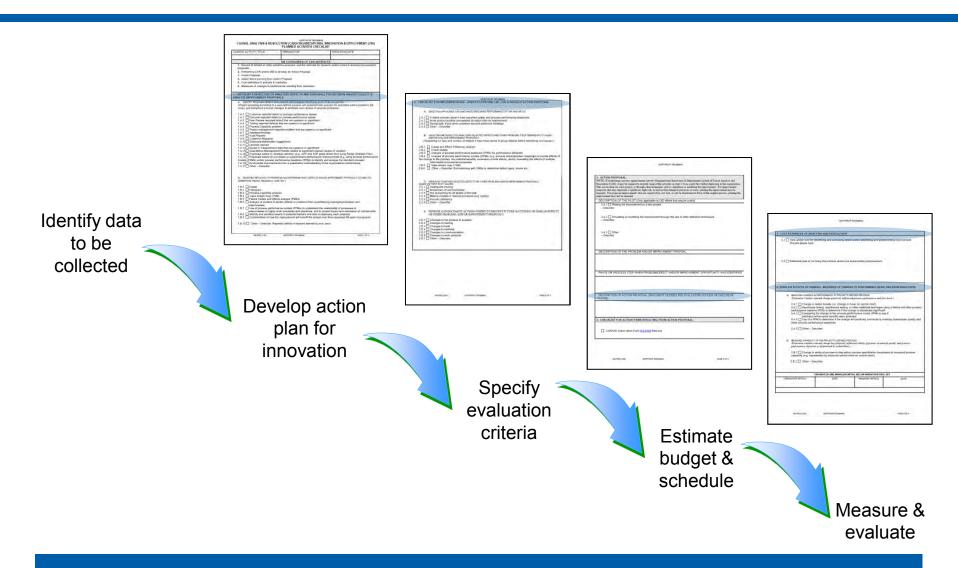
Weight the evaluation criteria

Rank & score the candidates to determine the best process improvements to work

#### Rank the Candidates Objectively

## Plan Obsessively





#### Plan to Execute Successfully

#### Success Is in the Details- 1



Artifacts generated by following this process



Triggering data or process condition



Business rationale



| NORTHROP GR                                   | RUMMAN                              |
|---|-------------------------------------|
| CAUSAL ANALYSIS & RESOLUTION (CAR)/ORGANIZAIT | CONAL INNOVATION & DEDLOYMENT (OID) |
|   |                                     |
| PLANNED ACTIVITES C                           | HECKLIST                            |

| CARGOID ACTIVITY TITLE   | OKIGINATOK                           | INITIATION DATE  |
|--|--------------------------------------|--|
|  |                                      |  |
|  | SIX CATEGORIES OF CAR A              | ARTIFACTS  |
|  | ems analyzed, and the rationale      | for decision and/or collect & analyze improvement  |
| proposals  | touris on Astion Bosses              |  |
| <ol> <li>Performing CAR and/or OID &amp; o</li> <li>Action Proposal</li> </ol> | levelop an Action Proposal           |  |
| Action Proposal     Action Items evolving from Action                          | on Bronocol                          |  |
| Cost estimates of analysis & res   |                                      |  |
| Measures of changes to perform   |                                      |  |
|  |                                      |  |
| 1. CHECKLIST FOR RECORD OF AN<br>ANALYZE IMPROVEMENT PROPOS                    |                                      | ONALE FOR DECISION AND/OR COLLECT &  |
| <ul> <li>A) IDENTIFY RELEVANT DEFECT DATA</li> </ul>                           |                                      |  |
| (Project operating according to a w<br>occur, and implement process cha        |                                      | tically analyze the operation where problems still   |
| occur, and implement process cha   | nges to eliminate root causes or     | selected problems)   |
| 1.A.1 Customer reported defect   |                                      | i e  |
| 1.A.2 End user reported defect 1.A.3 Peer Review reported de                   |                                      | ant  |
| 1.A.4 Testing reported defects   |                                      | ant  |
| 1.A.5 Process Capability proble  |                                      |  |
| 1.A.6 Project management rep   | orted problem that are systemic      | or significant   |
| 1.A.7 Appraisal findings 1.A.8 Audit Reports                                   |                                      |  |
| 1.A.9 Customer Requests  |                                      |  |
| 1.A.10 Employee/stakeholder su   | uggestions                           |  |
| 1.A.11 Lessons learned   |                                      |  |
| 1.A.12 Issues in measurement of<br>1.A.13 Quantitative Managemen               |                                      |  |
|  |                                      | F goals driven from Long Range Strategic Plan)   |
| 1.A.15 Proposals based on proc   | esses or subprocesses performa       | ance improvements (e.g. using process performanc   |
|  |                                      | lentify and analyze the standard process).   |
| 1.A.16 ☐ Incremental Improvemen<br>1.A.17 ☐ Other – Describe:                  | ts from a quantitative understand    | ding of the organizations performance  |
| Suid Booking.  |                                      |  |
|  |                                      |  |
|  |                                      | S AND/OR IMPROVEMENT PROPOSALS TO ANALYZE  |
| (Determine impact, frequency, cos  | i, etc.)                             |  |
| 1.B.1 Pareto   |                                      |  |
| 1.B.2 Histogram  |                                      |  |
| 1.B.3 ☐ Process Capability analy<br>1.B.4 ☐ Value stream map (VSM              |                                      |  |
| 1.B.5 Failure modes and effect   |                                      |  |
| 1.B.6 Analysis of clusters of sir  |                                      | uantitatively managed processes and  |
| subprocesses   | and an electric (DDMs) to understand | - d di l-di bi f   |
| 1.B.7 Use of process performa  |                                      | nd the relationship of processes or<br>nd to predict impact and calculation of cost benefits |
| 1.B.8 Identify and prioritize bas  |                                      |  |
|  |                                      | oject over time (expected life span of proposal)   |
| 4 B 40 D Other Breedhay Been   |                                      |  |
| 1.B.10 Other - Describe: Repo  | rieu delects in lessons learned b    | y end users  |

Document the Issue, Problem or Opportunity

#### Success Is in the Details - 2



Process performance impacts



Approach for root cause analysis



Root cause



Preventive & corrective actions



| NORTHROP GRUMMAN  |
|---|
| 2. CHECKLIST FOR IMPLEMENTATION – STEPS TO PEFORM CAR / OID & DEVELOP ACTION PROPOSAL   |
| A) SELECTING APPLICABLE CIRCUMSTANCES REQUIRING PERFORMANCE OF CAR AND/OR OID   |
| 2.A.1   |
| B) SELECTING METHOD(S) FOR ANALYZING SELECTED DEFECTS AND OTHER PROBLEMS TO DETERMINE ROOT CAUSES AND/OR EVALUATE IMPROVEMENT PROPOSALS (Depending on type and number of defects it may make sense to group defects before identifying root causes.)  |
| 2.B.1. Cause and Effect (Fishbone) diagram 2.B.2. Check sheets  |
| 2.B.3 Analysis of process performance baselines (PPBs) for performance attributes 2.B.4 Analysis of process performance models (PPMs) (e.g. process decomposition mappings) to predict effects of the change to the process, the potential benefits, evaluation of side effects, and/or evaluating the effects of multiple interrelated improvement proposals |
| 2.B.5  Value stream map (VSM) 2.B.6  Other – Describe: Brainstorming with SMEs to determine defect types, issues etc.   |
| C) GROUPING TOGETHER SELECTED DEFECTS OR OTHER PROBLEMS AND/OR IMPROVEMENT PROPOSALS BASED ON THEIR ROOT CAUSES 2.C.1 ☐ Inadequate training 2.C.2 ☐ Breakdown of communication 2.C.3 ☐ Not accounting for all details of the task 2.C.4 ☐ Making mistake in manual procedure (e.g. typing) 2.C.5 ☐ Process deficiency 2.C.6 ☐ Other - Describe:               |
| D) PROPOSE AND DOCUMENT ACTIONS NEEDED TO PREVENT FUTURE OCCURENCE OF SIMILAR DEFECTS<br>OR OTHER PROBLEMS AND/OR IMPROVEMENT PROPOSALS   |
| 2.D.1 Changes to the process in question 2.D.2 Changes to training 2.D.3 Changes to tools 2.D.4 Changes to methods 2.D.5 Changes to communications 2.D.5 Changes to compunications 2.D.7 Other – Describe:  |
|   |
|   |
|   |
|   |

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IORTHROP GRUMMAN

PAGE 2 OF 4

#### Investigate the Root Cause

#### Success Is in the Details - 3



NORTHROP GRUMMAN

3. ACTION PROPOSAL NOTE: If conducting a process improvement activity (Organizational Innovation & Deployment) instead of Causal Analysis and Resolution (CAR), it may be required to execute some of the activities in steps 3-6 on a pilot first before deploying to the organization. This can be done on a test project, or through other techniques such as simulation or modeling the improvement. For improvement proposals that may represent a significant, high risk, or irrevocable change to processes or tools, piloting the improvement may be required. For proposed improvements that are conservative, low risk, or can be abandoned in favor of the original process, piloting the improvement may not be required DESCRIPTION OF THE PILOT (Only applicable to OID efforts that require a pilot) 3.A.1 Piloting the improvement on a test project - Describe: 3.A.2 Simulating or modeling the improvement through the use of other statistical techniques Details of any pilot 3.A.3 Other - Describe: DESCRIPTION OF THE PROBLEM AND/OR IMPROVEMENT PROPSAL Proposal summary PHASE OR PROCESS STEP WHEN PROBLEM/DEFECT AND/OR IMPROVEMENT OPPORTUNITY WAS IDENTIFIED Life cycle impacts DESCRIPTION OF ACTION PROPOSAL (DOCUMENT CRITERIA FOR EVALUATING SUCCESS OR FAILURE OF CHANGE) Implementation & evaluation description 4. CHECKLIST FOR ACTION ITEMS RESULTING FROM ACTION PROPOSAL Detailed action items CAR/OID Action Items Form W2-F002 filled out W2-F003 (3-09) NORTHROP GRUMMAN PAGE 3 OF 4

#### Develop the Action Plan

#### Success Is in the Details- 4



Cost & schedule to implement



Cost if not implemented



Measured performance change



Measured process capability



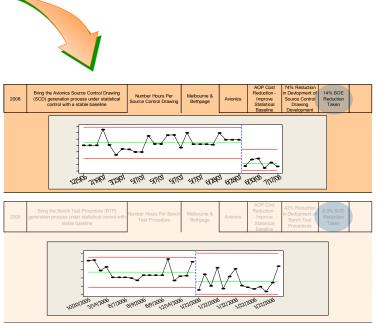
|   | Time and/or cost for  | LYSIS AND RESOLUTION identifying and correcting defect   | and/or identifying and imp | olementing improvement.      |  |  |
|---|-----------------------|--|----------------------------|------------------------------|--|--|
|   | Provide details here: |  |                            |                              |  |  |
| .2 🔲  | Estimated cost of no  | t fixing the problem and/or not im   | plementing improvement.    |                              |  |  |
|   |                       |  |                            |                              |  |  |
|   |                       |  |                            |                              |  |  |
| AULA  | TE EFFECTS OF CHA     | NGES - MEASURES OF CHANGES   | S TO PERFORMANCE RES       | ULTING FROM RESOLUTION       |  |  |
| A)  |                       | N PERFORMANCE OF PROJECTS DE<br>selected change positively influences  |                            | ow much.)                    |  |  |
| 6.A.1  Change in defect density (i.e. change in mean on control chart) 6.A.2  Hypothesis testing, significance testing, or other statistical technique using a before and after process performance baseline (PPB) to determine if the change is statistically significant 6.A.3  Comparing the change to the process performance model (PPM) to see if predicted performance benefits were achieved 6.A.4  Use of a PPM to determine if the change will positively contribute to meeting downstream quality and other process performance objectives |                       |  |                            |                              |  |  |
|   | 6.A.5  Other – D      | •  |                            |                              |  |  |
| B)  | (Determine whether s  | ( OF THE PROJECT'S DEFINED PROC<br>selected change has positively influe<br>es as determined by stakeholders.) |                            | net its quality and process- |  |  |
|   |                       | ability of process to stay within personal limits about 10 miles.  |                            | daries or improved process   |  |  |
|   | 6.B.2  Other – D      | escribe:   |                            |                              |  |  |
|   |                       | ORIGINATOR AND MANAGER INITI   | AL BELOW WHEN PROPOS       | AI SET                       |  |  |
| ORIG  | INATOR INITIALS       | DATE   | MANAGER INITIALS           | DATE                         |  |  |
|   |                       |  |                            |                              |  |  |
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#### Define the Resources & Document the Results

#### Market the Results







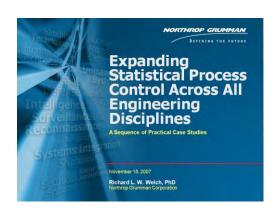


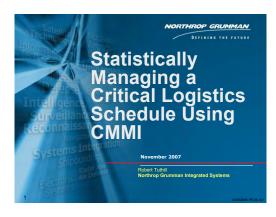
#### Keep Management Aware of the Value Provided

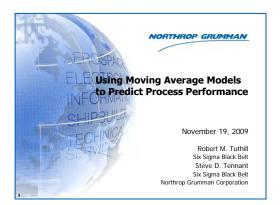
## More Examples from Past CMMI Conferences



- Presentations can be found at the DTIC's NDIA Conference Proceedings web site
  - http://www.dtic.mil/ndia/#s2009









## Making It Grow



Good Document the new process

Better Publish & deliver new training

• Best Change your engineering rates



When Managers See Money, Making the Next Business Case Gets Easier

## Making the Sale



And you have this . . .

... You now can make the business case for High Maturity



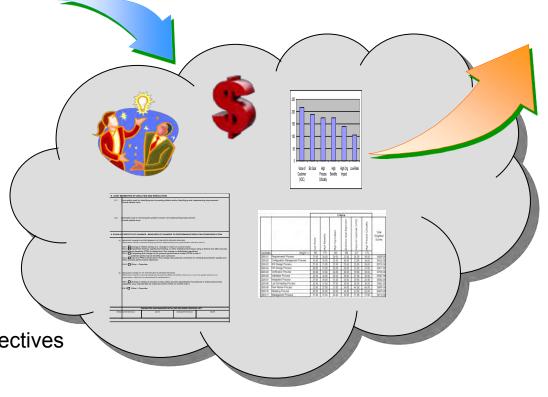


Organizational Goals & Objectives

Competing Resources

**Cost Constraints** 

**Competing Improvement Opportunities** 



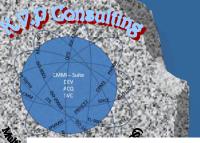
#### **QUESTIONS**



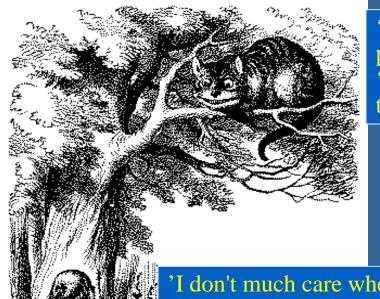


Richard L. W. Welch, PhD Northrop Grumman Corporation (321) 951-5072 Rick.Welch@ngc.com Robert M. Sabatino
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(321) 726-7629
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## NORTHROP GRUMMAN



## Why to Measure



'Cheshire Puss,' she began, ... 'Would you tell me, please, which way I ought to go from here?'

'That depends a good deal on where you want to get to,' said the Cat.

'I don't much care where –' said Alice.

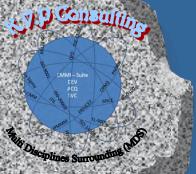
Then it doesn't matter which way you go,' said the Cat.

- so long as I get somewhere,' Alice added as an explanation.

'Oh, you're sure to do that,' said the Cat, 'if you only walk long enough.'

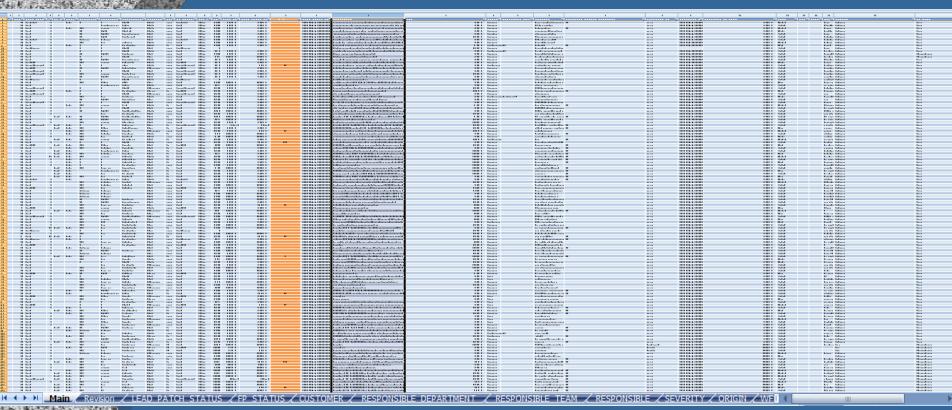


Tell me where you want to be and I will show (measure) you the way



"which way I ought to go from here"

# Bug Database



~33000 Records With 36 Attributes

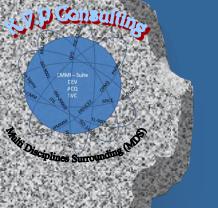
CAMAI Suite
DEV
ACC
VC
STC

"which way I ought to go from here"

# Call Center – Calls Database

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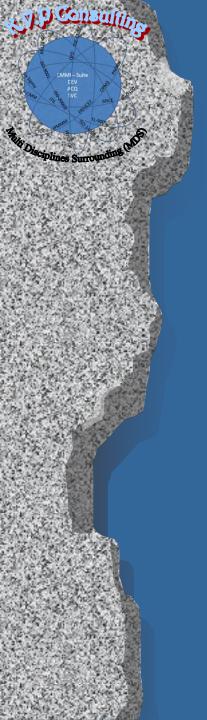
~45000 Records With 22 Attributes



"That depends a good deal on where you want to get to,' said the Cat."

# 'Immediate' Level Analysis

| Version View vs Other                           | Internal Status View vs Other        | Company View vs Other                           | Call View vs Other      | Priority View vs Other             | View Cross vs. LC Record    | Count of Call per View |
|---|--------------------------------------|---|-------------------------|------------------------------------|-----------------------------|------------------------|
| Version vs OnAir                                | Internal Status vs OnAir             | Company vs Status                               | <u>Call vs Status</u>   | Priority vs Environment            | Company & LC                | Priority               |
| Version vs Sub Module                           | Internal Status vs TargetMil         | Company vs Internal                             | Call vs Internal Status | <u>Priority vs Status</u>          | Priority & LC               | Company                |
| <u>Version vs Status</u>                        | Internal Status vs Sub               | Company vs OnAir                                | Call vs Company         | <u>Priority vs Internal Status</u> | Type of Call & LC           | Type of Call           |
| <u>Version vs Internal</u>                      |                                      | Company vs TargetMil                            | Call vs OnAir Module    | Priority vs Company                | Closed on Initial Call & LC | Closed on Initial Call |
| Version vs Call                                 | Status View vs Other Status vs OnAir | Company vs Sub Module                           | Call vs Target Mileston | Priority vs OnAir Module           | Status & LC                 | <u>Environment</u>     |
| Version vs Company                              | Status vs TargetMil                  |   | Call vs Environment     | Priority vs Target Milestone       | Internal Status & LC        | <u>Status</u>          |
|   | Status vs Sub Module                 | Environment View vs Other Environment vs Status | Call vs Sub Module      | Priority vs Sub Module             | Environment & LC            | Internal Status        |
| Sub vs TargetMi                                 |                                      | Environment vs Internal                         |                         | Priority vs Call                   | Version & LC                | <u>Version</u>         |
|   |                                      | Environment vs Company                          |                         |                                    | GoLive Target & LC          | GoLive Target          |
| OnAir Module View vs Other<br>OnAir vs TargetMi |                                      | Environment vs OnAir                            |                         |                                    | Target Milestone & LC       | OnAir Module           |
| OnAir vs Sub                                    |                                      | Environment vs TargetMil                        |                         |                                    | Sub Module & LC             | Target Milestone       |
|   |                                      | Environment vs Sub Module                       |                         |                                    | OnAir Module & LC           | Sub Module             |



# Utilizing Project Current Data for Better Management Decisions

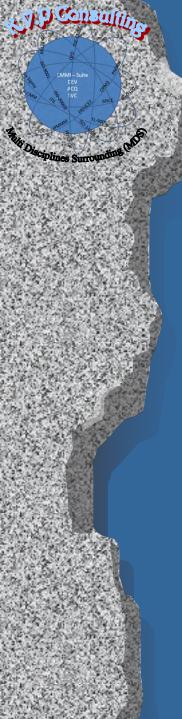
Increasing Project Data Usability
Real Life Case Study



## Disclaimer

We have based the presentation content on the current program raw data, therefore presentation accuracy or level details presented may impacted by it

• In some cases we guesstemate on data or some of its segments

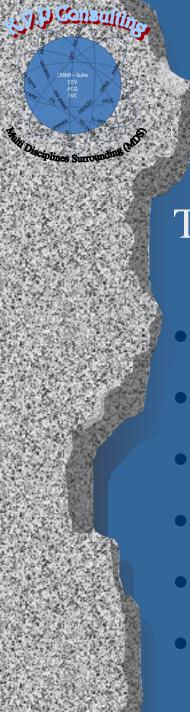


# Unit Improvement Objectives

• Improve communication among the different stakeholders

• Increase system interfaces management and control efficiency

 To increase insight to effort deviation for better planning



# Presentation Objectives

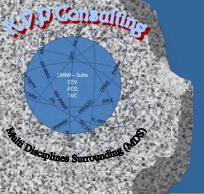
To give the program and the division ideas, how to:

- Increase product / deliverable quality
- Reduce project lifecycle duration
- Reduce project cost
- Increase resource (human) utilization
- Increase processes efficiency
- Have better control on effort distribution.

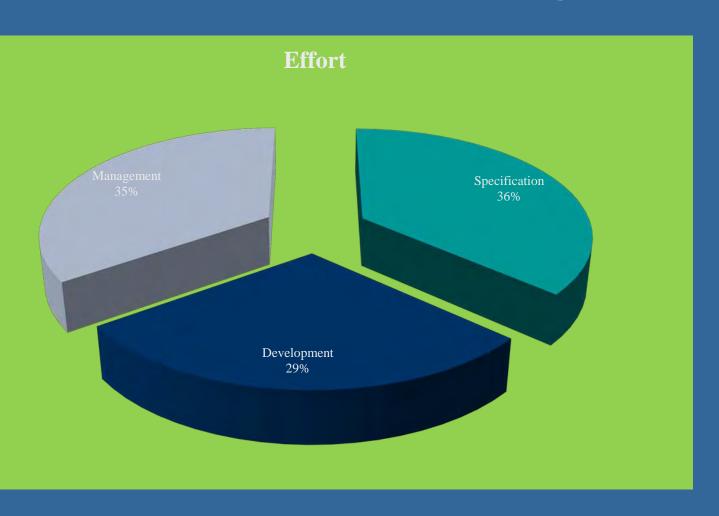


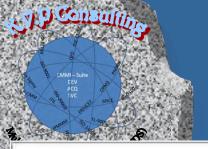
## The Presentation Will Not

- Give you detailed root cause analysis
- Will not provide silver bullets
- Will not solve your tomorrow problems
  - But it is practical for next phase



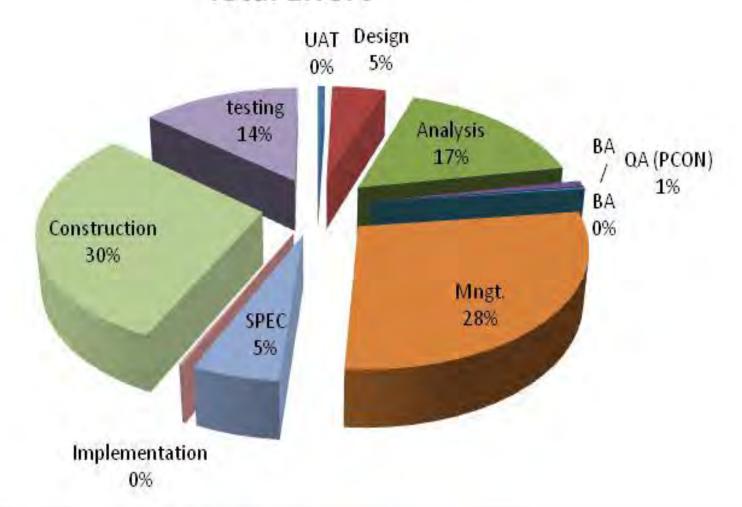
# Initial Effort Planning



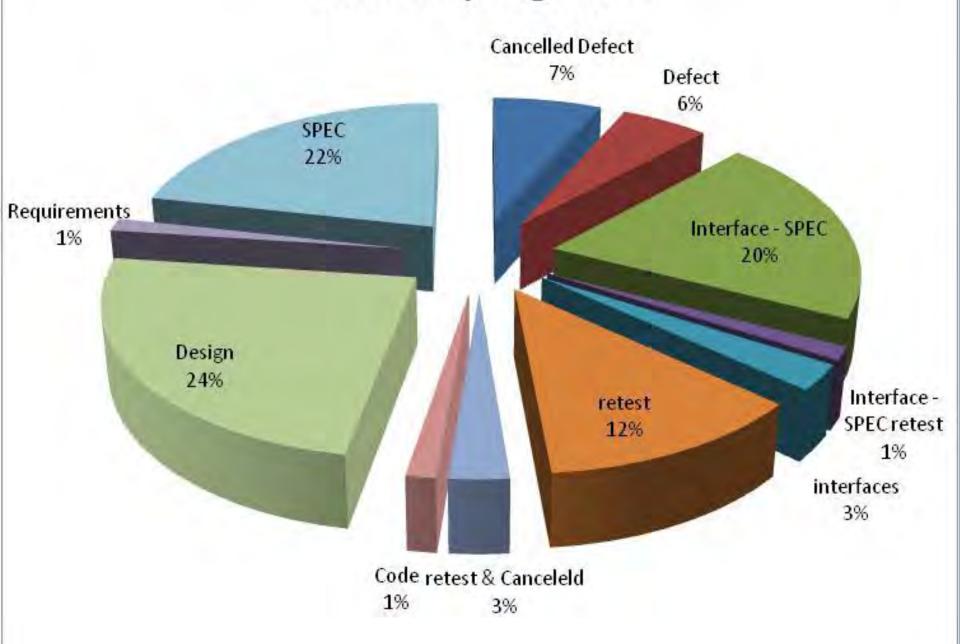


# Current Effort Distribution For all Project Phases

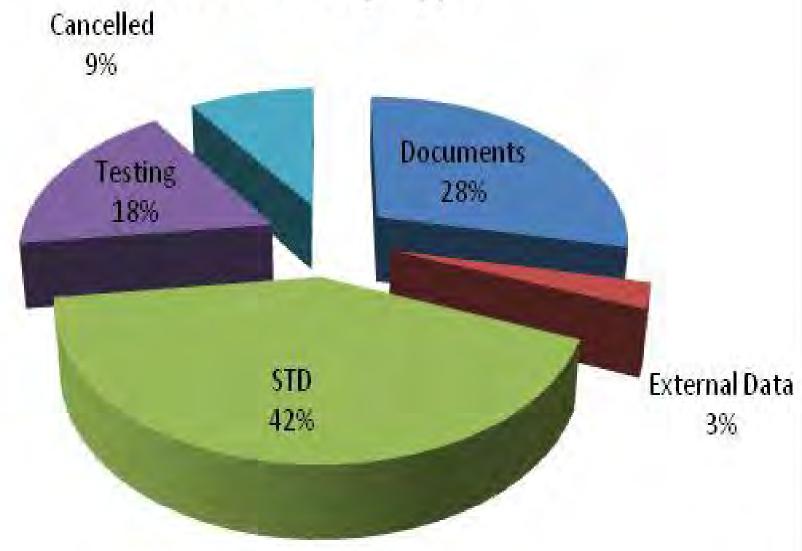
### **Total Effort**

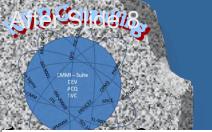


## **Defects by originator**

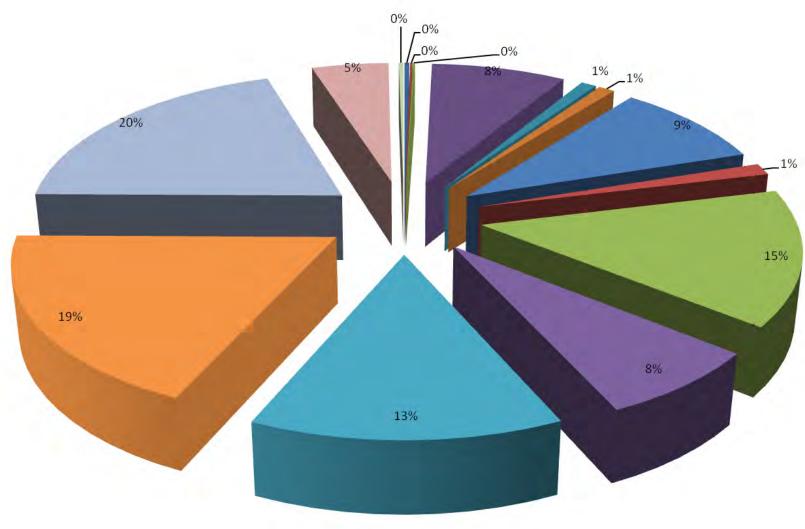


# **Defects by Type**

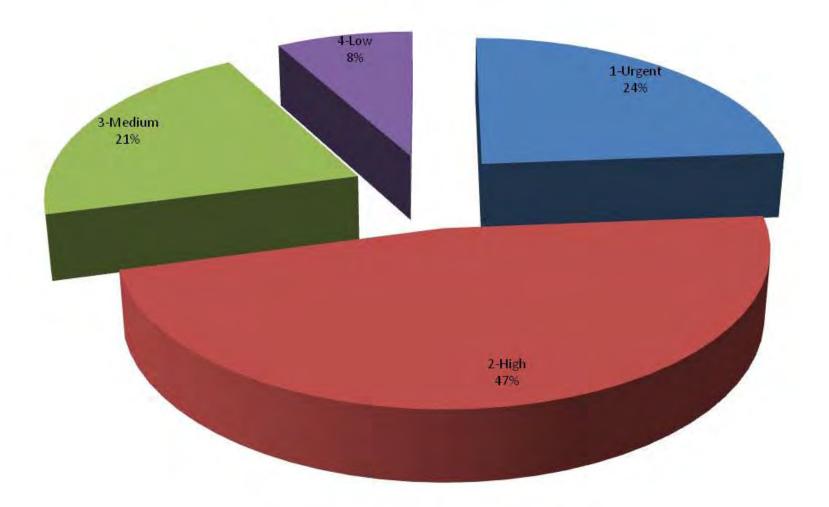




# Program Modules

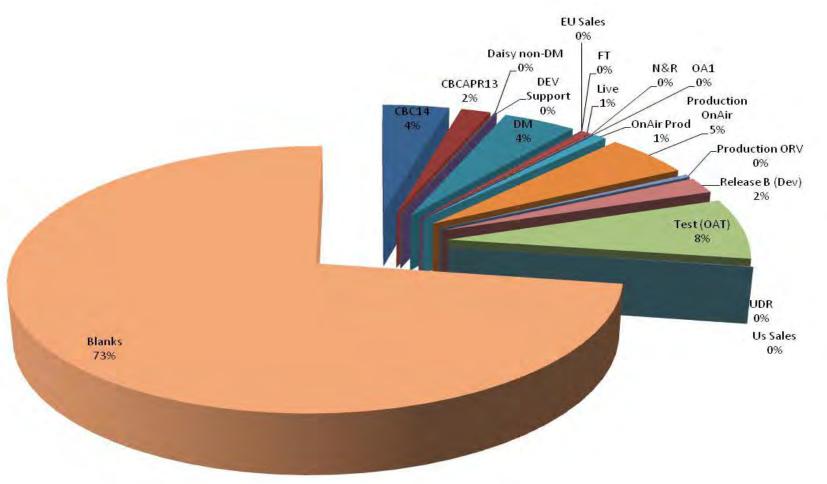


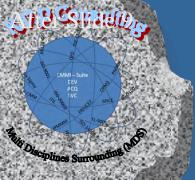




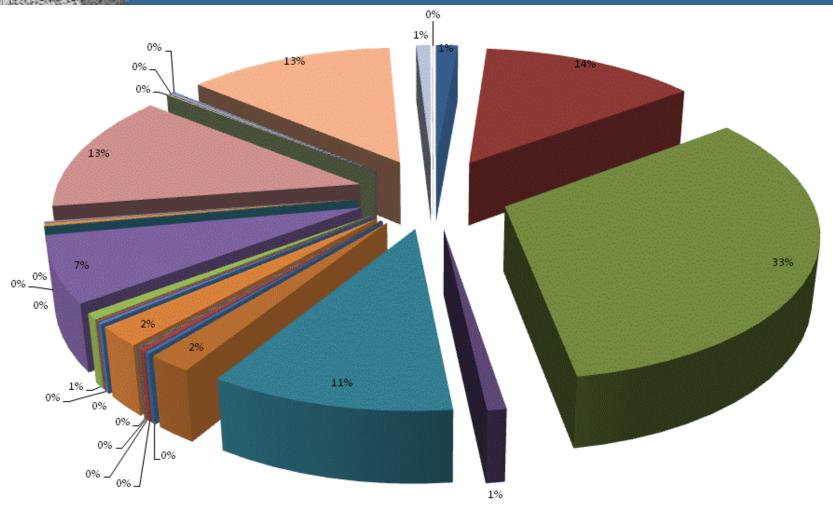


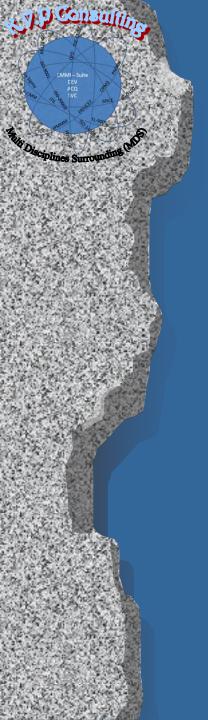
# Environments





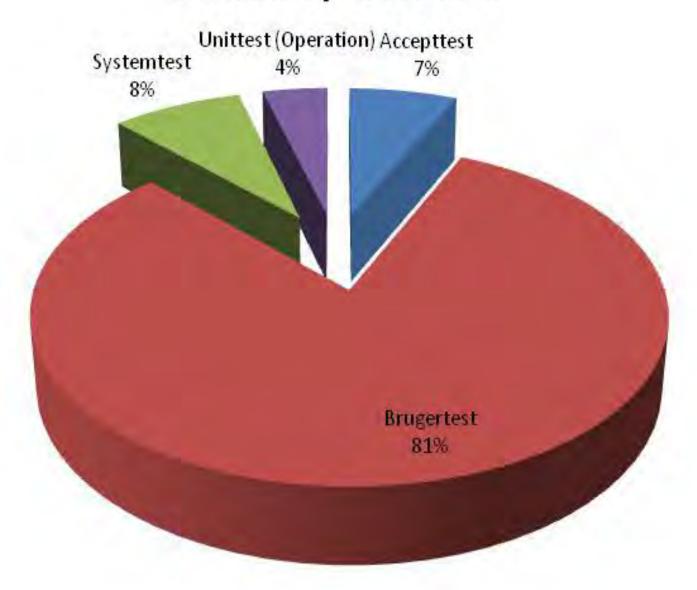
# Clients

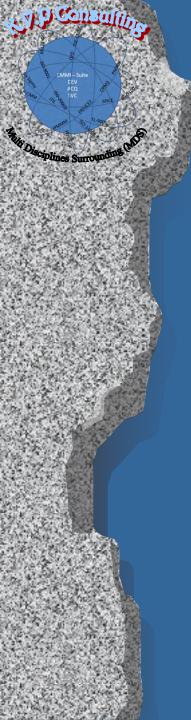




| All  | LC   | %    |
|------|------|------|
| 71   | 40   | 56%  |
| 693  | 575  | 83%  |
| 1670 | 1572 | 94%  |
| 43   | 24   | 56%  |
| 547  | 455  | 83%  |
| 102  | 44   | 43%  |
| 12   | 1    | 8%   |
| 15   | 7    | 47%  |
| 1    | 0    | 0%   |
| 4    | 1    | 25%  |
| 1    | 1    | 100% |
| 112  | 81   | 72%  |
| 13   | 6    | 46%  |
| 6    | 0    | 0%   |
| 36   | 20   | 56%  |
| 373  | 231  | 62%  |
| 2    | 0    | 0%   |
| 15   | 9    | 60%  |
| 7    | 4    | 57%  |
| 676  | 418  | 62%  |
| 5    | 5    | 100% |
| 15   | 7    | 47%  |
| 5    | 4    | 80%  |
| 661  | 569  | 86%  |
| 46   | 34   | 74%  |
| 2    | 0    | 0%   |
|      |      |      |

### **Defects by Test Level**

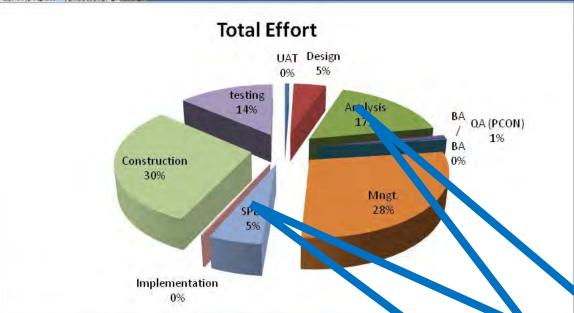


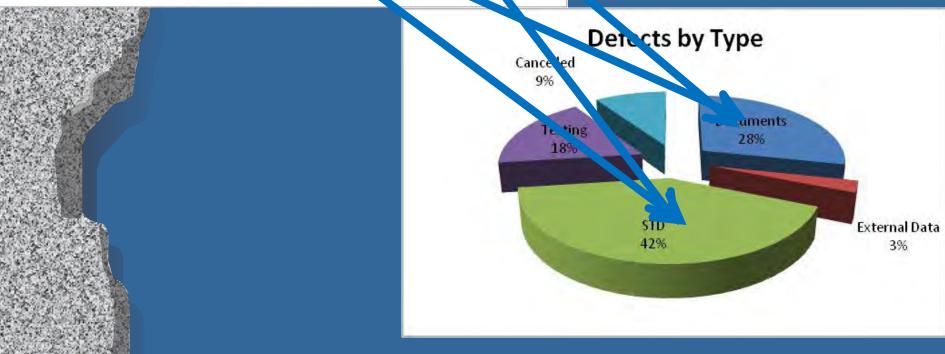


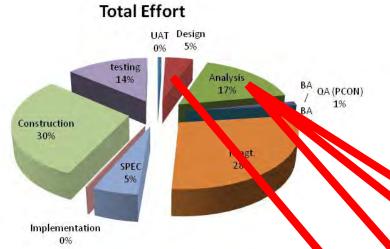
## Let's Try Some Mix and Match

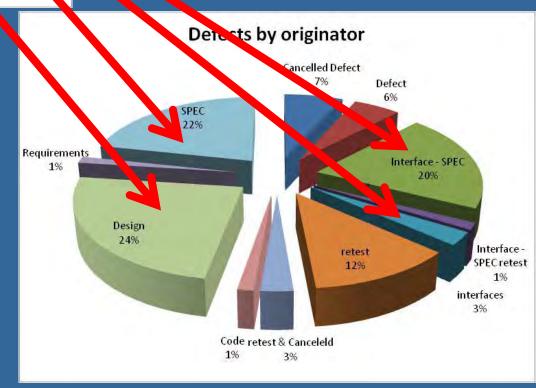
We Will Demonstrate How Relationships Between Measures Can Benefit the Organization for Better Planning and Management



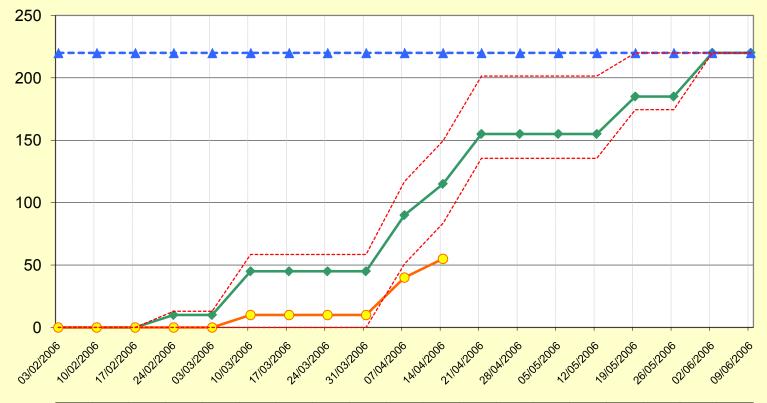




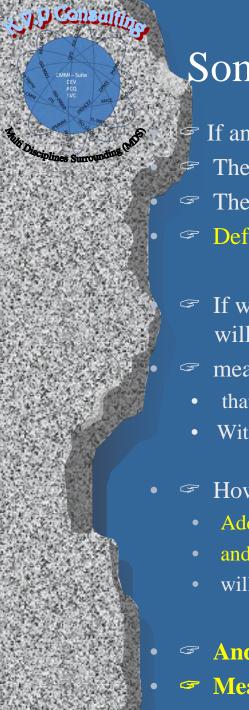




**Points** 

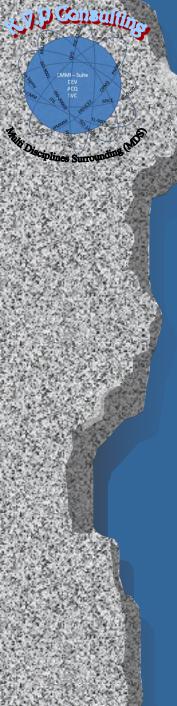


|          | 02/03/ | 02/10/ | 02/17/ | 02/24/ | 03/03/ | 03/10/ | 03/17/ | 03/24/ | 03/31/ | 04/07/ | 04/14/ | 04/21/ | 04/28/ | 05/05/ | 05/12/ | 05/19/ | 05/26/ | 06/02/ | 06/09/ |
|----------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
|          | 06     | 06     | 06     | 06     | 06     | 06     | 06     | 06     | 06     | 06     | 06     | 06     | 06     | 06     | 06     | 06     | 06     | 06     | 06     |
| Plan     | 0      | 0      | 0      | 10     | 10     | 45     | 45     | 45     | 45     | 90     | 115    | 155    | 155    | 155    | 155    | 185    | 185    | 220    | 220    |
|          | 0      | 0      | 0      | 0      | 0      | 10     | 10     | 10     | 10     | 40     | 55     |        |        |        |        |        |        |        |        |
| Baseline | 220    | 220    | 220    | 220    | 220    | 220    | 220    | 220    | 220    | 220    | 220    | 220    | 220    | 220    | 220    | 220    | 220    | 220    | 220    |
| Lower    | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 51     | 84     | 136    | 136    | 136    | 136    | 175    | 175    | 220    | 220    |
| Upper    | 0      | 0      | 0      | 13     | 13     | 59     | 59     | 59     | 59     | 117    | 150    | 202    | 202    | 202    | 202    | 220    | 220    | 220    | 220    |



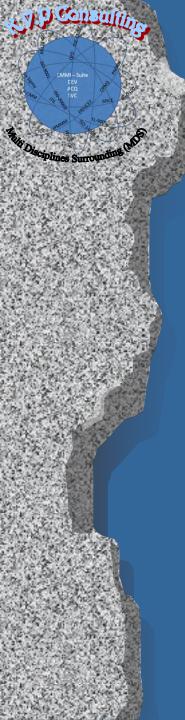
### Some guesstemations on cost effectiveness

- If an average developer day cost is ~7000units
- The total project effort was 10022 day (100%)
- The testing phase was 1453 day (14.5%)
- Defect that are the result of documentation are 69% of all defects
- If we will assume the to correct 69% of all defects will take around 40% of the testing duration;
- means that:
  - that will be 581 day
  - With the overall cost of 4068400units
- However
  - Adding 30 review days in the static tests
  - and another 80 days of code inspection
  - will end with the cost of 770000 units
- And still we have saved at least 9401000 units (1343 days)
- Means that we ware able to reduce 13.04% of the project time



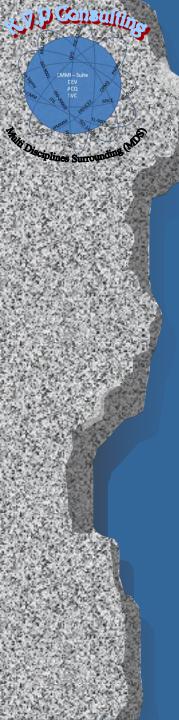
## What Organizational Processes we have touch

- Tailoring
- Scope and Size
- Status meetings
- Static Tests
- Testing (planning and execution) all phases
- Lesson learned
- Process Improvement



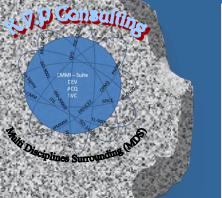
### CMMI Effecting PA's

- Project Planning
- Project Monitor and Control
- Measurement and Analysis
- Validation
- Verification
- Requirements Development
- Technical Solution
- Product Integration
- Organizational Process Focus



## Practical Improvements Suggestions

- Requirements Development
  - Writing
  - Verifying
  - Validating
- **Effort Distribution** 
  - Overhead planning
  - Estimation models
  - Project control
  - Lessons learned
- Verification
  - Planning
  - Guidelines for conducting
  - Checklist
  - Results analysis
  - Efficient communication
  - Lessons learned and root causes



| PHASE                         | PERCENT OF<br>EFFORT |
|-------------------------------|----------------------|
| Requirements Evaluation Phase | 8%                   |
| Project Planning Phase        | 3%                   |
| Analysis Phase                | 10%                  |
| Design Phase                  | 20%                  |
| Construction Phase            | 32%                  |
| Test Phase                    | 23%                  |
| Implementation Phase          | 1%                   |
| Customer Support Phase        | 2.5%                 |
| Completion Phase              | .5%                  |

| Characteristic           | Level       | Weightage                     |
|--------------------------|-------------|-------------------------------|
| Product complexity       | High        | 1.15                          |
| Main storage constraints | High        | 1.06                          |
| Applications experience  | Low         | 1.13                          |
| Programmer capability    | Low         | 1.17                          |
| All other characteristic | Nominal     | 1.00                          |
| Effort Adjustment Factor | 1.15 * 1.00 | 6 * 1.13 * 1.17 * 1.00 = 1.61 |

| Activity           | Small Project | Medium Project | Large Project |
|--------------------|---------------|----------------|---------------|
| User Documentation | 10            | 05             | 03            |
| Project Management | 25            | 15             | 10            |
| Quality Assurance  | 15            | 10             | 10            |
| User Training      | 10            | 07             | 02            |
| Acceptance Testing | 10            | 05             | 05            |
| Performance Tuning | 05            | 08             | 10            |
| Totals (%age)      | 75            | 50             | 40            |

| IMPERATIVE      | OCCURRENCE |
|-----------------|------------|
|                 |            |
| shall           | 0          |
| must            | 46         |
| is required to  | 0          |
| are applicable  | 0          |
| are to          | 0          |
| responsible for | 0          |
| will            | 18         |
| should          | 3          |
|                 |            |
| TOTAL           | 67         |

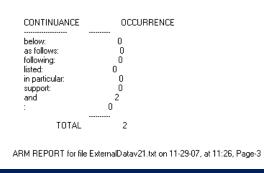
ARM REPORT for file ExternalDatav21.txt on 11-29-07, at 11:26, Page-2

|                  | NUME<br>DEPTH | BERING STRUC<br>OCCURRE |         | SPECI<br>DEPTH   | FICATION STRUCTURE<br>OCCURRENCE |
|------------------|---------------|-------------------------|---------|------------------|----------------------------------|
|                  | 1             | 2201                    | 1       | 49               |                                  |
|                  | 2             | 81                      | 2       | 2                |                                  |
|                  | 3             | 55                      | 3       | 14               |                                  |
|                  | 4             | 54                      | _4      | 2                |                                  |
|                  | 5             | 0                       | 5       | Ū.               |                                  |
|                  | 6             | 19                      | 6       | U                |                                  |
|                  | 7             | 0                       | 7       | Ü                |                                  |
|                  | 8             | 0                       | 8       | Ü                |                                  |
|                  | 9             | 0                       | 9       | 0                |                                  |
|                  |               |                         | _       |                  |                                  |
| $\mathbb{I}_{-}$ | TOTAL         | 2410                    | T       | OTAL             | 67                               |
| 1                | ARM I         | REPORT for file         | Externa | alDatav21.txt on | 11-29-07, at 11:26, Page-8       |

| DIRECTIVE                   | OCCURRENCE  |
|-----------------------------|-------------|
| e.g.<br>i.e.<br>For example | 0<br>1<br>0 |
| Figure<br>Table<br>Note:    | 0<br>0<br>0 |
|                             |             |
| TOTAL                       | 1           |

ARM REPORT for file ExternalDatav21.txt on 11-29-07, at 11:26, Page-4

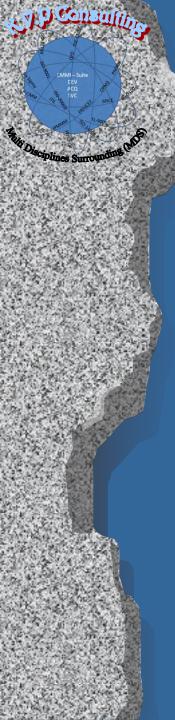
| ı | WEAK PHRASE OCCURRENCE  |
|---|---|
| ı | as appropriate 0<br>be able to 0                                      |
| ı | be capable of 0<br>capability of 0                                    |
| ı | capability to 0<br>effective 0  |
| ı | as required 0 normal 0  |
| ı | provide for 0<br>timely 0   |
| ı | easy to 0   |
| ı | TOTAL 0   |
| l | ARM REPORT for file ExternalDatav21.txt on 11-29-07, at 11:26, Page-6 |



ARM REPORT for file ExternalDatav21.txt on 11-29-07, at 11:26, Page-5

| INCOMPLETE   | OCCURRENCE                          |  |
|--|-------------------------------------|--|
| TBD TBS TBE TBC TBR not defined not determined but not limited to as a minimum | <br>0<br>0<br>0<br>0<br>0<br>0<br>0 |  |
| TOTAL  | 0                                   |  |

ARM REPORT for file ExternalDatav21.txt on 11-29-07, at 11:26, Page-7



## Practical Improvements Suggestions

#### Validation

- Planning
- Guidelines for conducting
- Checklist
- Results analysis
- Efficient communication
- Lessons learned and root causes

#### Measurements

- Definition with direct line to business objectives
- Measurements structures, content and context
- Guidelines for collecting and 'work with'
- Checklist
- Results analysis
- Efficient communication
- Lessons learned and root causes

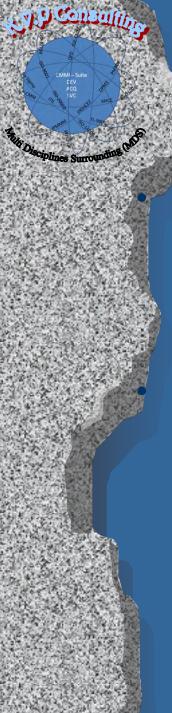
### **3**

#### Control Measures

|              | 10 V E-F 2 V TOPUS TORIOS |                                   |   |
|--------------|---------------------------|-----------------------------------|---|
| iite         | Computed Metric Name      | Alias                             | Objective of Computed Metric  |
| in the       | ⊟ACWP                     | HELACTUAL COST OF WYORK PERFORMED | Identify the actual labor hours spent on the project to date.                   |
| 7            | ⊟BAC                      | ■ Budget at Completion            | Identify the project's budget.  |
| The state of | ⊟BCWP                     | <u>-</u>                          | Identify budgeted labor hours associated with the work that has been completed. |

#### Performance Measures

| VELLE - 10   | Goal                 |   | Metric                         |  |                          | frequency<br>(dev) |
|--|----------------------|---|--------------------------------|--|--------------------------|--------------------|
| できたがい  | Improve productivity | How efficient are tests?                          | Testing efficiency             | Defects detected through testing /<br>hour of testing  | DTS                      | Monthly            |
| S. S. S. S.  |                      | How efficient are reviews?                        | Review efficiency              | Defects detected through reviews<br>/ hour of review   | DTS                      | Monthly            |
| The state of the s |                      | What is the productivity in fixed price projects? | Productivity                   | (Actual size of the product<br>delivered to the customer / Actual<br>effort spent to complete the<br>project) in each technology<br>platform | PINS (add size<br>field) | End of the project |
|  |                      | How effective is best practices sharing?          | KR artifact usage index        | KR artifacts used / project  | KR                       | Monthly            |
| は ない ない は でき   | Carried Co.          |   | KR artifact contribution index | KR artifact added / project  | KR                       | Monthly            |



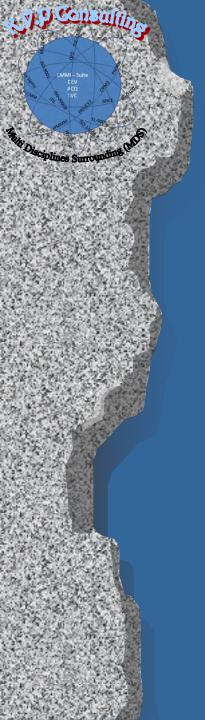
## Practical Improvements Suggestions

#### Development & Interfaces Integration

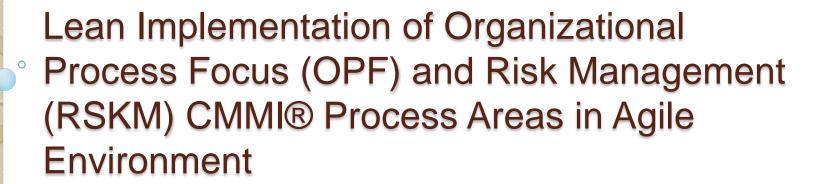
- Improve content of guidelines in the different technical document to build more strong and clear descriptions
- Peer reviews
- 'Internal' documentation

#### Quality Assurance and Process Improvements

- Identify process goals and targets with direct line to business objectives
- Plan to process evaluation; including:
  - Guidelines for conducting
  - Checklist
  - Results analysis
  - Efficient communication
  - Lessons learned and root causes



## Questions



### **Ahmed Mahdy**

Senior Software Engineer & Agile Coach, Raya Software. SW Process Improvement Consultant

<u>aamahdys@gmail.com</u> <u>ahmed\_mahdy@rayacorp.com</u>



### Prerequisites

### Basic background about:

- Agile Values & Principles (www. agilemanifesto.org)
- CMMI version 1.3 (www.sei.cmu.edu/cmmi)

### Feasibility of Agile and CMMI

- "The two methods are certainly compatible" Mike Konrad, Senior Member of Technical Staff Software Engineering Process Management Program
- "It was an opportunity for us at SEI to dispel some myths and 'apologize', in a sense, to some people in the Agile community" Mike Konrad
- Why Not Embrace Both technical report by SEI
- Jeff Sutherland Recommends Combining Scrum with CMMI Level 5 Jeff Sutherland is one of scrum inventors
- And Others ... (www)

## Feasibility of Agile and CMMI (Cont'd)

- Our Own Various Implementations
- One of the successful companies that applied Agile CMMI in the same team & project with light-weight processes is:

Raya Information Technology, Egypt (<a href="http://www.rayacorp.com">http://www.rayacorp.com</a>)



# (Cont'd) They are Synthetically welded?



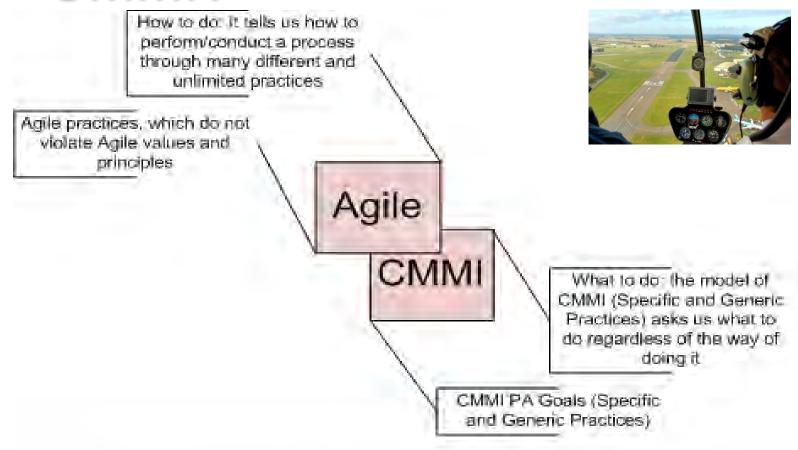
Permission of image copy is down this slide

# (Cont'd) But, they are



CMMI 10th Annual Technology Conference and User Group Association

## How do we look at Agile CMMI?

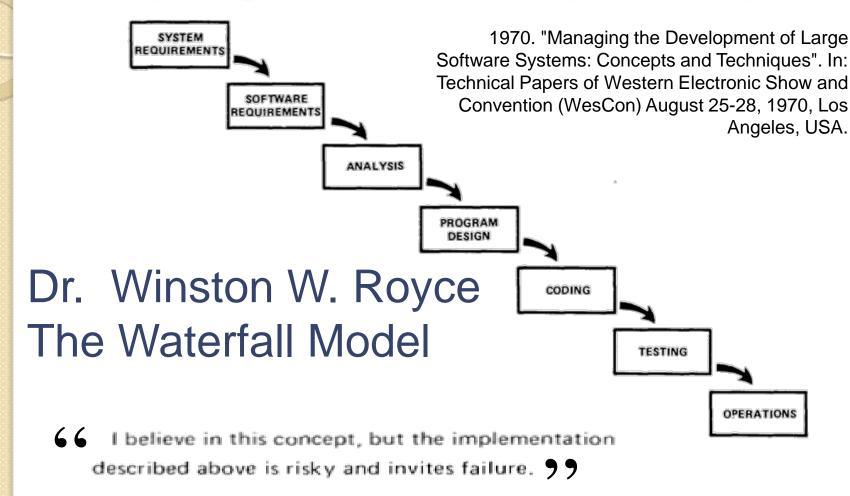


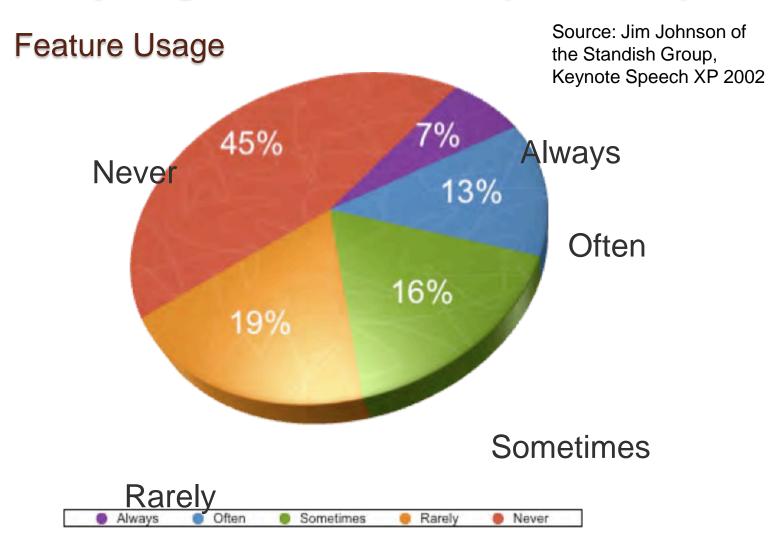
Brief Relationship between Agile and CMMI from Implementation perspective

### Why Agile CMMI?

- Easily understanding of model intent,
- Thinking in terms of valuable compliance instead of just compliance or filling contract requirement,
- Paying more attention to people,
- Managed fast deliverables.

- Heavy-weight processes lead to:
  - a late delivery,
  - an inaccurate assurance of quality,
  - a misleading way to the required value,
  - a more budget,
  - a lot of workarounds by stakeholders to survive!
- Remember, there are some competitors over there!







Source: Jim Johnson of the Standish Group, Keynote Speech XP 2002



- We need to focus more of prioritizing features and delivering value quicker than focusing on implementing all the features
- •We need to focus on the ROI of each feature for your customer with the help of customer
- •We need to focus on the ROI of each feature as a product manager

#### Sometimes



Dr. Sidky: Introduction to Agile

**Challenged Projects** 

USA: \$80-145 billion per year is spent on failed and cancelled projects

UK:12 out of 18 Large IT projects have failed



Standish Report - 2006

Dr. Sidky: Introduction to Agile



#### However,...

#### Market value of publicly traded shares:

```
$NA (31 December 2009 est.)

<u>country comparison for the world</u>

$34.95 trillion (31 December 2008)

$64.56 trillion (31 December 2007 est.)
```

#### Industries:

dominated by the onrush of technology, especially in computers, robotics, telecommunications, and medicines and medical equipment; most of these advances take place in OECD nations; only a small portion of non-OECD countries have succeeded in rapidly adjusting to these technological forces; the accelerated development of new industrial (and agricultural) technology is complicating already grim environmental problem

#### Industrial production growth rate:

CIA World Factbook- 2010



#### However,...

#### Market value of publicly traded shares:

\$NA (31 December 2009 est.)
country comparison for the world

- •What if we increased our IT profits to both vendor and client?
- •What if we eliminated (or decreased) the challenged, failed and canceled projects?

dominated by the onrush of technology, especially in computers, robotics, telecommunications, and medicines and medical equipment; most of these advances take place in OECD nations; only a small portion of non-OECD countries have succeeded in rapidly adjusting to these technological forces; the accelerated development of new industrial (and agricultural) technology is complicating already grim environmental problem

#### Industrial production growth rate:

CIA World Factbook- 2010

## What is "Agile CMMI Practice" or ACP?

 Agile CMMI Practice (ACP) is the practice (or way of doing an activity) that achieves the Specific Practice (SP) in CMMI Model given that this practice achieves at least one of Agile Values and Principles without violating any of them.

Given that CMMI model defines the Alternative Practice as a practice that is a substitute for one or more generic or specific practices contained in CMMI models that achieves an equivalent effect toward satisfying the generic or specific goal associated with model practices. Alternative practices are not necessarily one-for-one replacements for the generic or specific practices.

10th Annual Technology Conference and User Group - 16 - NDIA - National Defense and Industria

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### Remember: Agile Values

- We are uncovering better ways of developing software by doing it and helping others do it. Through this work we have come to value:
  - Individuals and interactions over processes and tools
  - Working software over comprehensive documentation
  - Customer collaboration over contract negotiation
  - Responding to change over following a plan
     That is, while there is value in the items on the right, we value the items on the left

## In 7 Steps, how do you achieve

- Make sure of your senior management adoption,
- Discuss the policy and process improvement project vision by reaching consensus with all stakeholders about the vision and goals of this project,
- Specify the process areas in scope (i.e. what?), 3.
- Meet the users (actual implementers) of each practice in the selected process areas,
- Explore, with the implementers, all possible valuable ways of doing these practices which do not violate any of Agile Values and Principles,
- Consolidate the output from users to reach the way of implementing the selected process areas and implicitly its practices (i.e. how?)
- Inspect and adapt (i.e. process improvement cycle is always active)
  0th Annual Technology Conference and User Group

## Difference Between "Convey" and "Preserve" Information

|       | "Convey" Information   | "Preserve" Information  |
|-------|--|---|
| Why?  | Transfer information within your team members  | Store information for further references, reviews, reuses   |
|       | for alignment and having the same understanding  | and organization history.   |
|       | of this information.   |   |
| How?  | It depends on the case you have, that's why Agile is human-centric, you choose the best way for conveying information in your case. And do not forget that one of Agile principles is "the most efficient and effective method of conveying information to and within a development team is face-to-face conversation", however, if there are rigid constraints in achieving this way, move to the next communication way which invites interaction within team members. This encourages you to achieve the first step of SAMI (Sidky Agile Measurement Index), it is a 5-step value-based roadmap to agility and designed to help guide organizations seeking to become more agile. Each of SAMI's 5 steps (Collaborative, Evolutionary, Integrated, Adaptive and Encompassing) aims to instill a new value in teams and organizations. | Also, it depends on the case. Usually, people prefer usin different types of documentations project management tools, document management systems and we prefer using a system that supports your files' configurations such a version history details. |
| When? | In every time the team members communicate any information regarding the project   | In all legal and formal communications. And when yo want to ensure commitment and understanding of an information or responsibilities with either the customer of project team members.   |

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- 19 - NDIA - National Defense and Industrial

## What is the worst thing you can do for your organization?

Wrong implementation of CMMI, an implementation that leads to appraisal satisfaction or compliance regardless of the values and benefits that CMMI intends to provide, is the worst thing you may ever give to your business or or wrong.

WAY

GO BACK

### Purpose:

The purpose of Organizational Process Focus (OPF) is to **plan**, **implement**, and **deploy** organizational process improvements based on a thorough understanding of current strengths and weaknesses of the organization's processes and process assets.

 Is it an Agile process? Does it support any of Agile Principles?

# Yes!

## Agile Principle #12:

"At regular intervals, the team reflects on how to become more effective, then tunes and adjusts its behavior accordingly."

- Process Improvement Main Activities
  - Getting feedback from all team members
  - Decide if the feedback will be taken as an improvement request, if not, justify it with the owner of this feedback
  - Include the feedback to Process Improvement Live Plan
  - Update the process asset library with the new changes, and give a training to the teams
  - Deploy the updated processes
  - How you can make it? It is totally yours!

#### Organization Process Focus Strengths and Weaknesses Description: it contains the action items that are resulted from the strengths and weaknesses Attributes: Action, Responsibility, Implementation Due date, Affected Process(es), Original Strength or Weaknesses Description: it is just doing the action item and it is expected that it makes a change in the existing processes or adds new processes. Do not forget: your company vision Feedback and policy while you are going to take any process improvement action, In consistency and alignment is not an option. You could not make it? return to Retros the senior management and discuss their vision and related policy for reaching the alignment and consistency Deploy Description: it is deploying the new/modified processes in real or pilot projects. Do not forget before deployment: train people Improvement \$ on the changes and keep them updated and synchronized with process improvement activities Results or process asset library changes.

Organizational Process Focus (OPF) in Agile organizations

Ahmed Mahdy – aamahdys@gmail.com

- Feedback Check Points
  - Iteration/Sprint Retrospective (freq.1-3 weeks)
    - Positives (or what the team should keep doing?)
    - Negatives (or what the team should stop doing?)
    - Ideas (anything the team wants to say for improvement)
    - Action Items
    - Also, you can give the training of any new change to the team without requesting trainings! That's why we are coaching



- Check points (cont'd)
  Release Retrospective (freq. 4-6)
  - Release Retrospective (freq. 4-6 weeks)
    - Positives (or what the team should keep doing?)
    - Negatives (or what the team should stop doing?)
    - Ideas (anything the team wants to say for improvement)
    - Action Items (including monitoring previous action items)
    - Also, you can give the training of any new change to the team without requesting

CMMI 10th Annular arming Scinfere ich and Ser Grwhy - We Near elation Godon and Ser Grwhy - We Near elation

## Risk Management (RSKM)

### Risk Management Activities

- Identify ownership and responsibility of each activity
- Identify risk and define its attributes (category, probability, impact, mitigation, owner of this mitigation, status)

# Risk Management (RSKM) – Check Points

- Project Team Kickoff
- Client /Project Kickoff
- Release Planning
- Iteration/Sprint Retrospective (freq.1-3 weeks)
  - Negatives
  - Risks (Add new risks, and update the status of previous risks)
  - Action Items of "risk mitigation" type

# Risk Management (RSKM) – Check Points

- Release Retrospective (freq.4-6 weeks)
  - Negatives
  - Risks (Add new risks, and update the status of previous risks)
  - Risk mitigation action items

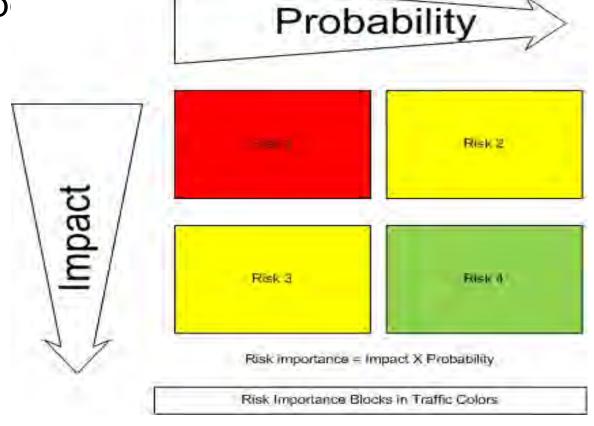
# Risk Management (RSKM) – Recommendations

 Use a tracking system for managing your project/company risks and related mitigation action items.

- Radiate, if possible, project risks and related mitigation action items.
- Use constant colors in differentiating among risks' probabilities or impacts (i.e. importance)

## Risk Management (RSKM) -Recommendations

 Use constant colors in differentiating among risks' probabilities or impacts (i.e. Risk Imp



## Important! Conclusion

It is not only possible to embrace both agile and CMMI, but also it is easier and proven practically. The presentation is not supposed to show best practices for your organization, the fore mentioned practices may not work in your organization.

However, inspect and adapt to reach the most appropriate practice that adds the **best possible value** to your organization and **your client**. Also, because agile mindset supports CMMI model intent, we found an easy implementation that we cannot work without.

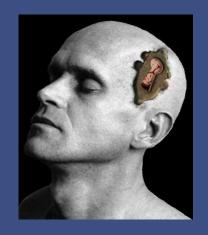
## Thank You!

Other Questions...?

Part of the content is a result of contribution from:

Mr. Elmohanned Ahmed (elmohanned\_ahmed@rayacorp.com)





Leveraging Capability Maturity
Model Integration for Acquisition
(CMMI®-ACQ) Processes to
Improve Organizational Workforce
and System Acquisition
Performance

10<sup>th</sup> Annual NDIA CMMI® Technology Conference and Users Groups Denver, CO 15 – 18 November 2010 Dr. Kenneth E. Nidiffer & Rick Barbour Software Engineering Institute Carnegie Mellon University Pittsburgh, PA 15213 703-908-1117

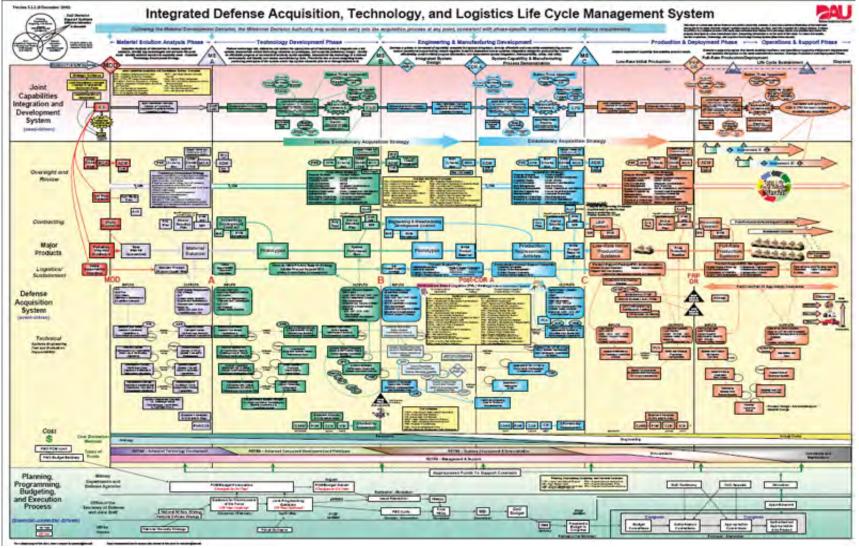
#### **Overview**



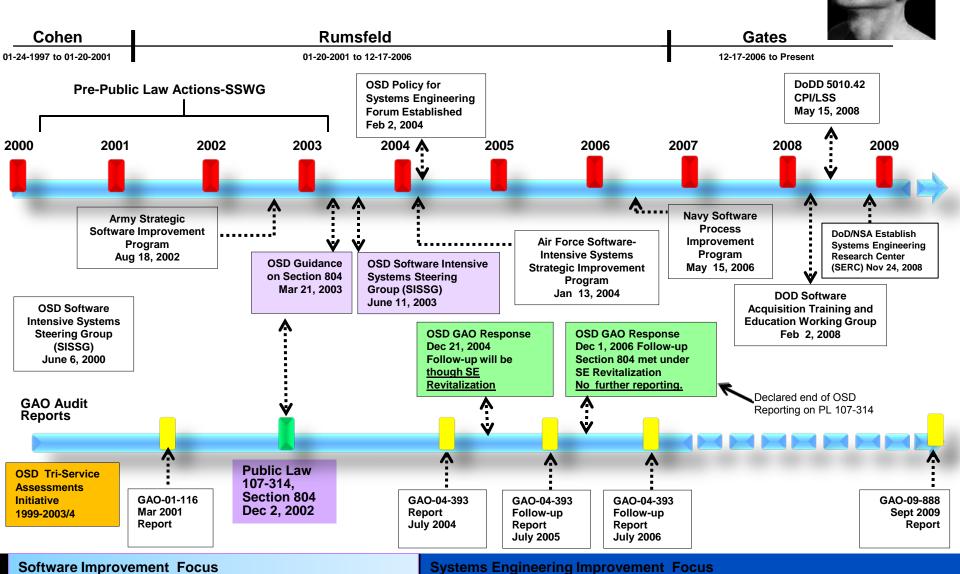
- Is your organization working towards achieving acquisition excellence?
  - The application of systems-engineering to improve the workforce may be part of the answer!
- What are the rate-limiting variables/drivers that limit success?
- How can the CMMI® ACQ model be used?

Achieving Acquisition Excellence via Effective Application of CMMI®-ACQ

# An Effective Process for Major Defense Systems – but not very agile



## DOD Software Acquisition Process Improvement Programs DoD Major Events and Leadership Rotation





Gap Analysis

### **DDR&E Imperatives**

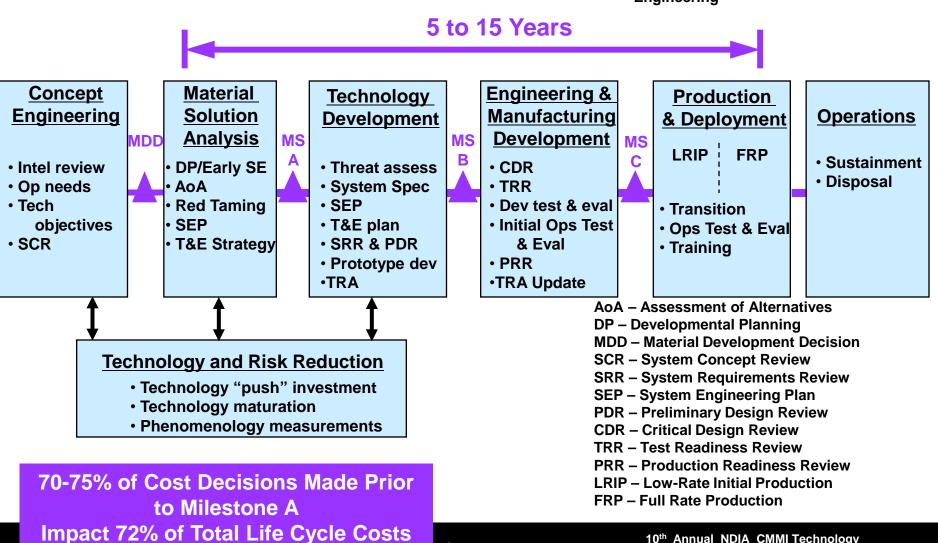


- Accelerate delivery of technical capabilities to win the current fight.
- 2. Prepare for an uncertain future.
- 3. Reduce the cost, acquisition time and risk of our major defense acquisition programs.
- 4. Develop world class science, technology, engineering, and mathematics capabilities for the DoD and the Nation.

Source: The Honorable Zachary J. Lemnios Director, Defense Research and Engineering

### **External Forces: Defense Acquisition Approach** Systems Engineering is key discipline

Source: The Honorable Zachary J. Lemnios **Director. Defense Research and Engineering** 



# 23 Principal Actions to Improve Efficiency within 5 Major Areas (14 September 2010)



- 1. Target Affordability and Control Cost Growth
- 2. Incentivize Productivity and Innovation in Industry
- 3. Promote Real Competition
- 4. Improve Tradecraft in Services Acquisition
- Reduce Non-Productive Processes and Bureaucracy

# Defense Science Board Report & Public Law 111 (Section 804)



DOD acquisition process is too long and too cumbersome to fit the needs of the many IT systems that require continuous changes and upgrades



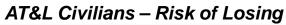
Task Force on
Department of
Defense
Policies and
Procedures for
the Acquisition of
Information
Technology
March 2009

The National Defense Authorization Act for Fiscal Year 2010 ("the Act") Public Law 111 includes a significant set of legislative provisions that modify Department of Defense (DoD) procurement policies and practices.

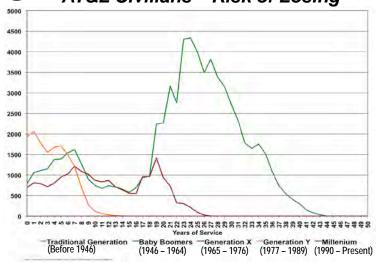


The National Defense Authorization Act for Fiscal Year 2010 ("the Act") Public Law 111 (Section 804)

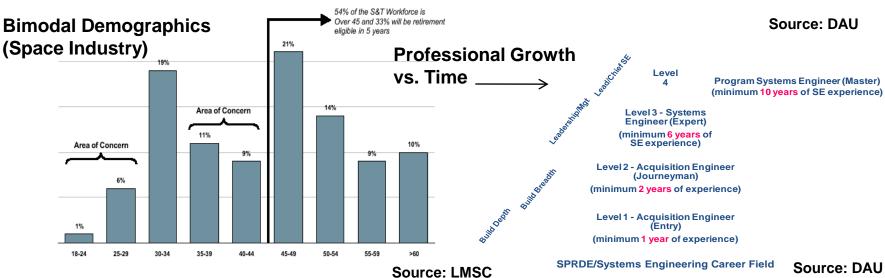
#### **External Forces**







Source: DAU

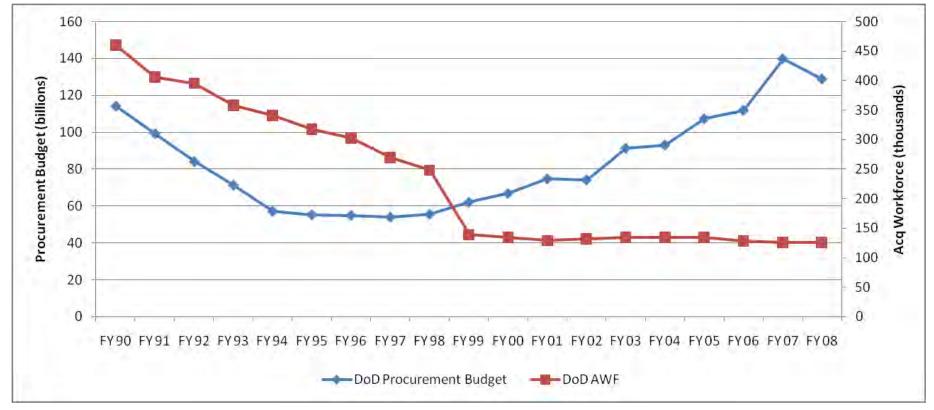


**Carnegie Mellon** 



### Procurement Budget vs. DoD Acquisition Workforce





Increasing # of Procurements & Complex Systems Coupled With Huge Decrease In Acquisition Workforce

Carnegie Mellon





#### **Problem**

- Acquisition capability has slowly atrophied
- Organic Workforce reductions 23% since 1999
  - Force shaping, reduced training, retirements of critical cost estimators, price analysts, experienced system engineers, contracting officers

#### **Initiatives**

- Recapitalize the Acquisition Corps/Training
- OSD Funding Increased Numbers and Training of Organic Acquisition Personnel

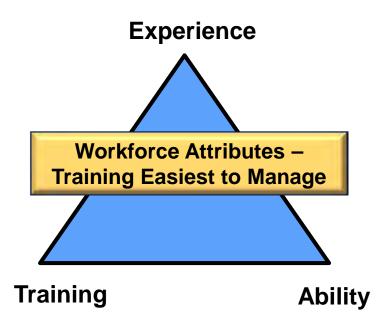
It May Not Be All About the Acquisition Workforce – But Viable Solutions Must Consider the Human Element!



### **Project Purpose**



Use a systems engineering approach to assess acquisition training and organizational training processes for improving acquisition excellence





#### **Business Motivation**



#### Internal

 Improve organization's performance efficiencies by putting in place trained workforce that can leverage suppliers' capabilities to deliver quality solutions rapidly, at lower costs, and with appropriate technology

#### External

President Barack Obama – Mar/May 2009
 "The government will assist agencies in assessing the capacity and ability of the Federal acquisition workforce to develop, manage, and oversee acquisitions" and Weapon Systems Acquisition Reform Act of 2009, Public Law 111-23, 22 May 2009

## **Summary of Systems Engineering Drivers**



#### **External Forces**

- Increasing size of untrained defense acquisition workforce
- Retiring of experienced and capable workforce

#### **Technological**

- Accelerating technological changes makes systems specific acquisition training difficult at best
- Identifying future competencies to ensure most relevant training content

#### **Human Capital**

 Changing workforce demographics requiring newer methods of training and management

#### Client Business Environment

Achieving acquisition excellence in a fiscally constrained environment

## What Is the Cyber Environment?

#### Includes all

- System of Systems
- Architecture
- Services
- Netted Hardware/ Platforms
- People who digitally connect to cyberspace



Cyberspace is where our daily work and our priority missions are conducted

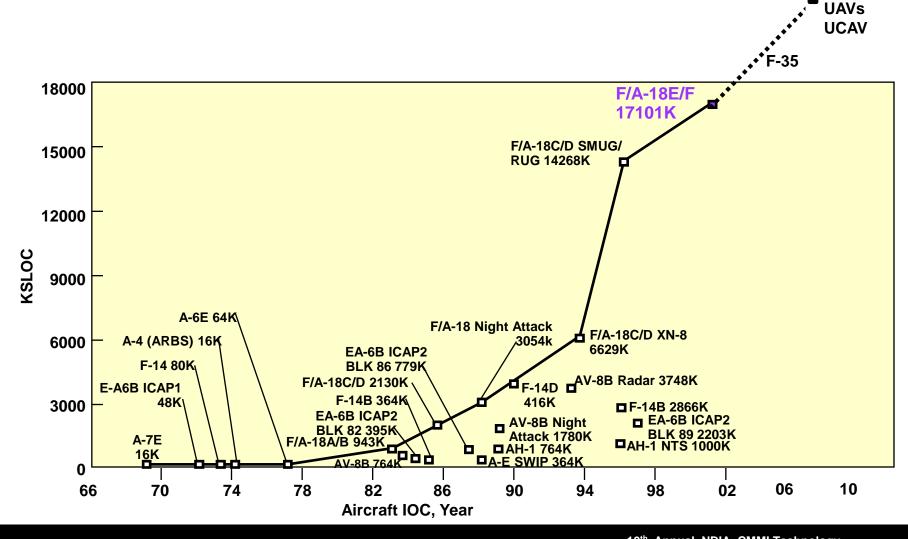
#### **Federal IT Market Growth**

In the next five years, IT contractors will see the federal market for their services increase by a compound annual growth rate of 5.4 percent to a total of \$111.9 billion by 2015.

...spending with contractors will outpace overall IT growth

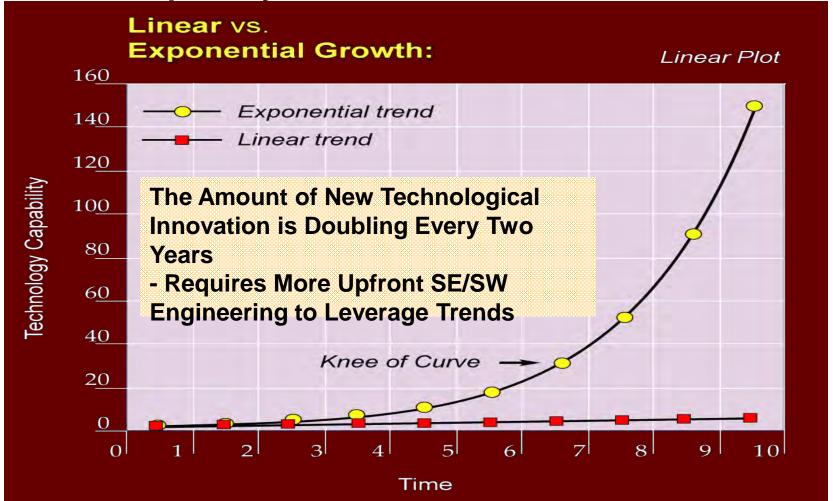
Ben BainFederal Computer WeekApril 8, 2010

# Increasing Software Lines of Code & Complexity



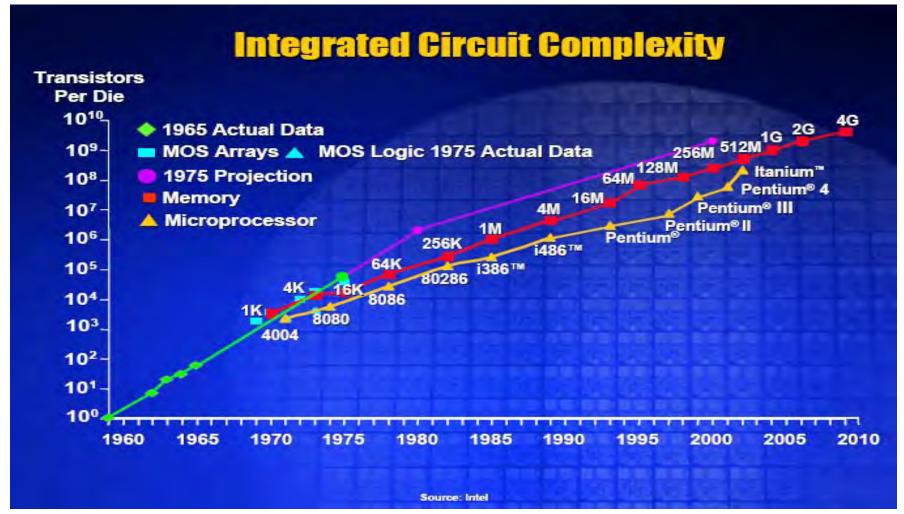
# Technological: Acceleration of Innovation in the 21st Century - Facilitating Our Ability to Build Move Complex Systems





# Technological: Moore's Law Holding - The Number of Transistors That Can be Placed on an Integrated Circuit is Doubling Approximately Every Two Years



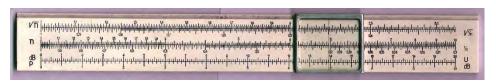




### Technological: Augustine's Law Holding - Growth of Software is an Order of Magnitude Every 10 Years



#### In The Beginning









F-4A 1000 LOC



1970's



F-15A *50,000* LOC



1980's



F-16C 300K LOC



1990's



F-22 1.7M LOC



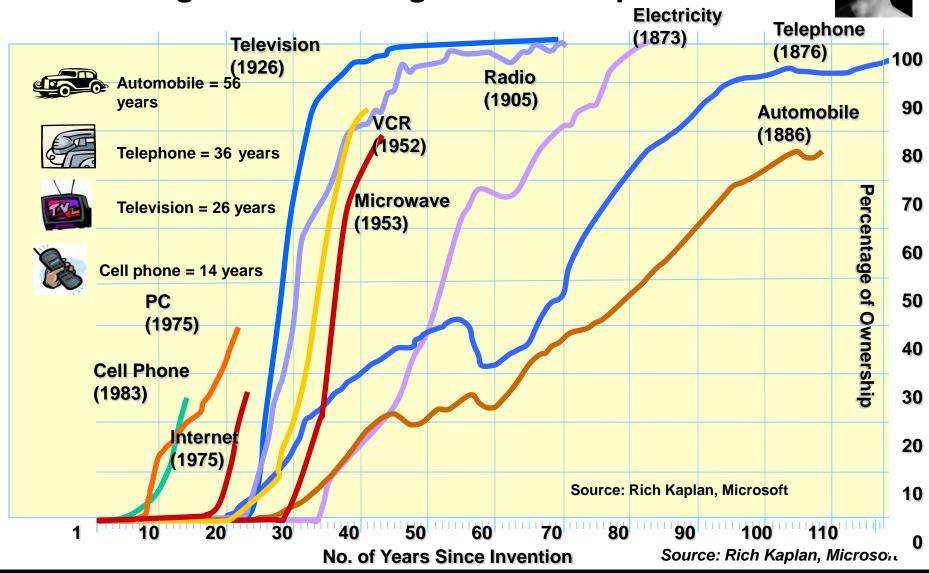


F-35 >6M LOC

2000+



#### **Technological: Increasing Rate of Adoption**

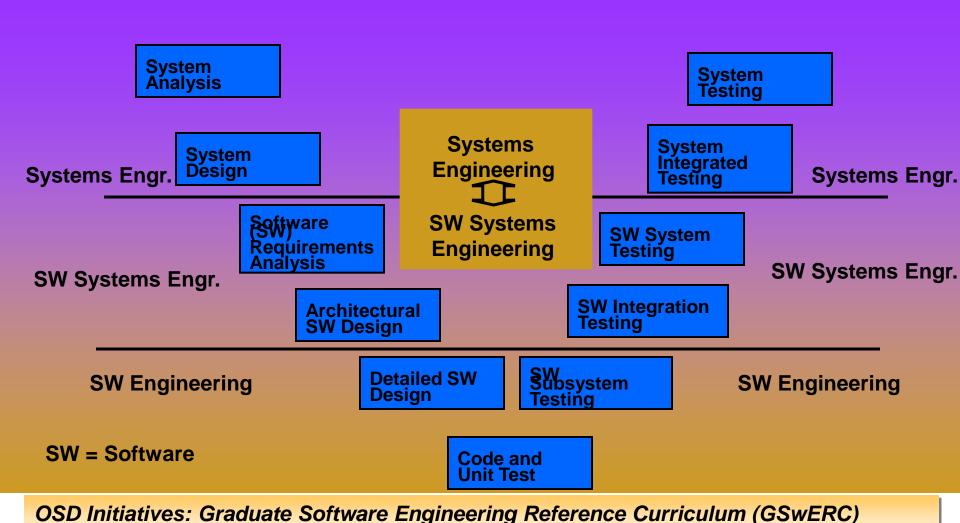


Carnegie Mellon



## Human Capital: Refocusing University Curriculums - Alignment of Software Systems Engineering





& Body of Knowledge and Curriculum to Advance Systems Engineering (BKCASE)

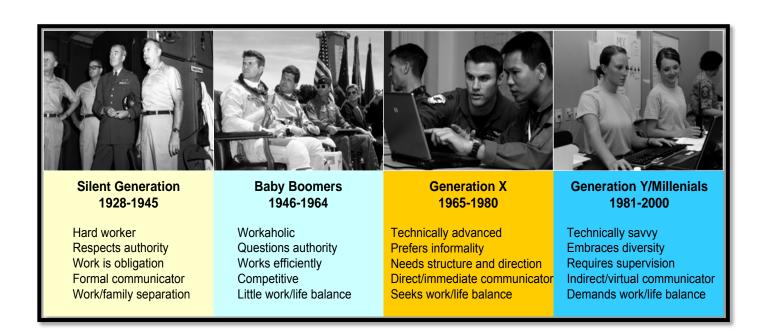


## **Human Capital: Changing Demographics**



Demographics of workforce are changing and different views may emerge with four generations to consider

Generation Y professionals entering workforce will likely necessitate non-traditional training techniques, such as virtual approaches



### **Client Business Environment: Increasingly Complex**



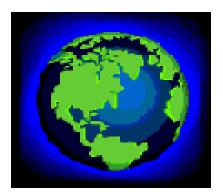
| Characteristics                  | Commercial<br>Software Products                               | Information Technology &<br>Internet Financial Services | Government Aerospace<br>Systems               |
|----------------------------------|---|---|---|
| Market                           | Commercial  | Information technology & internet                       | Government                                    |
| Industry                         | Software  | Financial   | Aerospace                                     |
| Packaging                        | Products  | Services  | Systems                                       |
| Primary Output                   | Software  | Integrated system engr &<br>HW & SW & network           | Integrated system engr &<br>HW & SW & network |
| Purpose                          | User empowerment:<br>effectiveness,<br>efficiency, creativity | Organization/business operations                        | Mission/science<br>capabilities               |
| Project Duration                 | 1-36 months   | 1-18 months   | 6 months - 10 years                           |
| Team Size                        | 1-1000's  | 1-1000's  | 10's-1000's                                   |
| Ratio of Custom<br>to COTS/Reuse | Software: Low-high  | Business logic: High<br>Others: Low                     | All: High                                     |
| Agreement                        | License   | Service level agreement                                 | Contract                                      |
| Customer                         | External  | Internal and external                                   | External                                      |
| # Customers                      | 100's-1,000,000's   | 1-1,000,000's   | 1   |
| Focus                            | Features, Time-to-<br>market, Ship it                         | User experience, Workflow cycletime, Uptime             | Reliability, Milestones,<br>Interdependencies |

Source - Northrop Grumman



### Client Business Environment: Acquisition Shifts

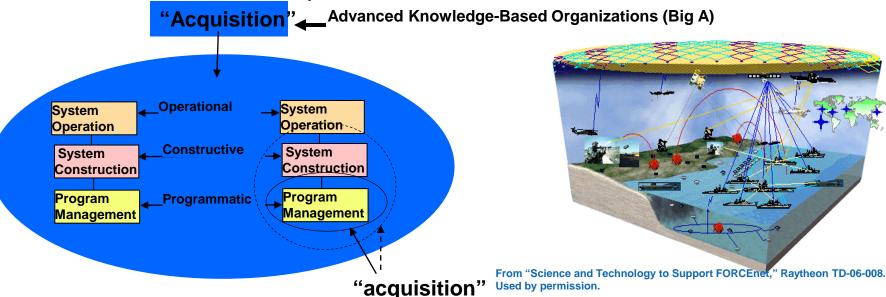




2005 study confirmed\*:

- In advanced knowledge-based organizations, management's desire for the flow of knowledge is greater than the desire to control boundaries
- Unlike the matrix organization, there is less impact on the dynamics of formal power and control

<sup>\*</sup> Using Communities of Practice to Drive Organizational Performance and Innovation, 2005, APQ study

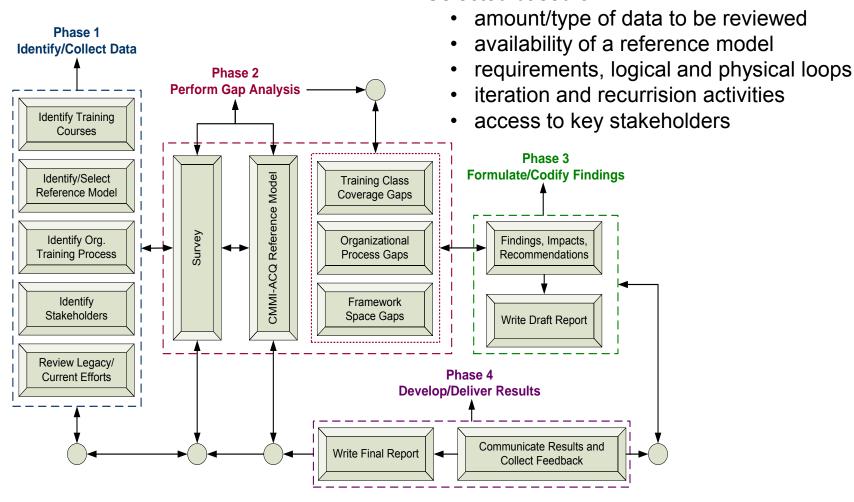


Ref: Jim Smith, (703) 908-8221,jds@sei.cmu.edu

### Systems Engineering Approach



#### Selected based on



### **Project Objectives**



During assessment Phase 1 project objectives were formulated in terms of five questions

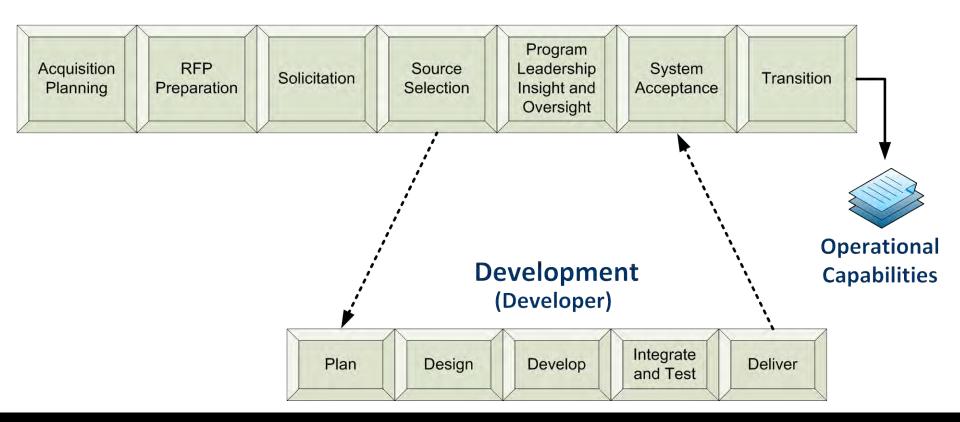
- Do coverage gaps exist in the training of acquisition best practices?
- Do gaps exist in acquisition training on the unique aspects of the client's system acquisitions?
- Do gaps exist in the training of the client's acquisition lifecycle framework and processes?
- Do best-practice gaps exist in the client's organizational training processes?
- Do gaps exist in identifying training requirements for satisfying the acquisition workforce core competencies?

### Assessment Framework: CMMI®-ACQ



#### **Operational Need**





## CMMI® -ACQ categories and process areas



| Category              | Process Area   |
|-----------------------|--|
| Acquisition           | Agreement Management (AM) Acquisition Requirements Development (ARD) Acquisition Technical Management (ATM) Acquisition Validation (AVAL) Acquisition Verification (AVER) Solicitation and Supplier Agreement Development (SSAD) |
| Process<br>Management | Organizational Innovation and Deployment (OID)  Organizational Process Definition (OPD)  Organizational Process Focus (OPF)  Organizational Process Performance (OPP)  Organizational Training (OT)                              |
| Project<br>Management | Integrated Project Management (IPM) Project Monitoring and Control (PMC) Project Planning (PP) Quantitative Project Management (QPM) Requirements Management (REQM) Risk Management (RSKM)                                       |
| Support               | Causal Analysis and Resolution (CAR) Configuration Management (CM) Decision Analysis and Resolution (DAR) Measurement and Analysis (MA) Process and Product Quality Assurance (PPQA)   |

CMMI® -ACQ model was developed to codify best practices to help organizations improve acquisition processes

CMMI® reference models have gained significant traction across commercial and defense community and are widely used throughout world [CMMI Product Team 07]

### **Summary of Results**



- Strengths
- Areas for Improvement
- Lessons Learned



### Results – General Overall Strengths



- Excellent coverage in the training of acquisition best practices
- Adequate number and variety of course offerings
- Simple but adequate training facilities
- Consistency of course material & presentation layout & style
- Variety of media used for announcing upcoming courses
- Scope and breath of Earned Value programs
- Knowledgeable SME\* teach classes
- Talented instructor workforce
- Intelligent student population
- Professionalism of the training staff
- Desire to improve

### Representative Results: Question 1



#### Question 1: Do Coverage Gaps Exist in the Training of Acquisition Best Practices?

#### **Findings**

Detailed findings awaiting client approval

#### **Impacts**

- Missing opportunities to
  - ~ attract more students
  - ~ provide training on the most relevant issues
  - ~ effectively plan
  - ~ save resources
  - ~ provide a richer variety of courses
  - ~ continuously improve training processes

#### **Recommendations and Considerations**

- Conducting a review to assess use of web-based and non-traditional acquisition training
   Consider: Leveraging of efforts by DAU,
  - **Consider:** Leveraging of efforts by DAU, commercial industry and academia
- Conducting a review of best practices for training among different types of acquisitions
  - **Consider:** Developing and teaching approaches that focus on agile and SOA acquisition approaches
- Making a better use of repository information
   Consider: Using DAU's Acquisition Best Practices
- Putting a systematic process improvement program in place

Consider: Using CMMI-ACQ and IDEAL

 Developing a strategic plan
 Consider: Socializing plan among relevant stakeholders

#### Results



| Findings  | 25 |
|---|----|
| Impacts   | 20 |
| Recommendations   | 23 |
| Considerations/ Potential Solutions - ways to address some of the recommendations | 40 |

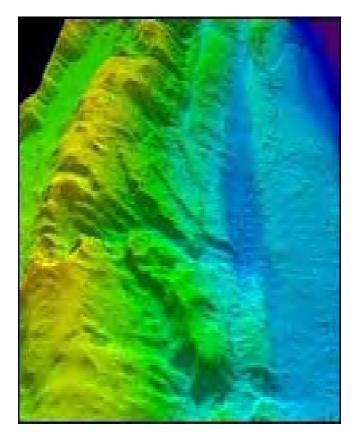
Systematic Improvement in Client's Organizational Training Processes Needed

#### **Lessons Learned**



#### Tsunami

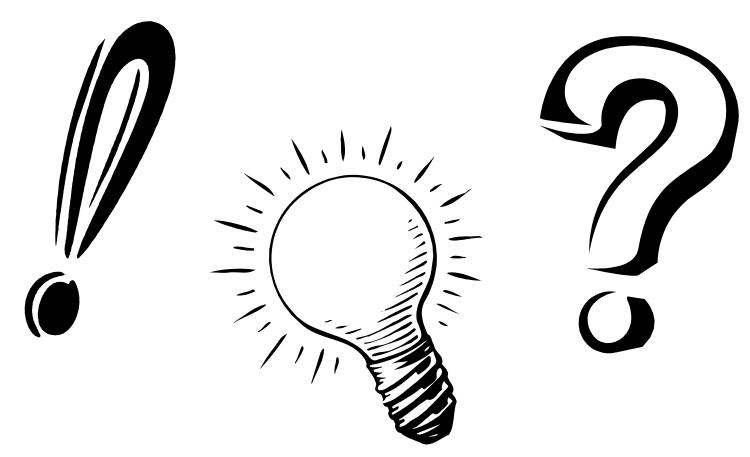
- Tsunami-like impacts on new acquisition training requirements
  - Rapid, large-scale disturbance of current training needs envisioned
  - Forces will include technological, human capital, external and government needs
- Training departments have incorporated best acquisition practices into their training courses; however
  - Mapping of core competencies to training courses needs to be done
  - Training architectures needed
- Developers of organizational training processes could benefit from the application of systems engineering



**Images of the Ocean Floor** 

### Wrap Up





#### **Contact Information**



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Fax: + 1 703-908-9317

Email: <u>nidiffer@sei.cmu.edu</u>

### Systems Engineering Drivers for Improving Acquisition Excellence



- External Forces
- Technological
- Human Capital
- Client Unique

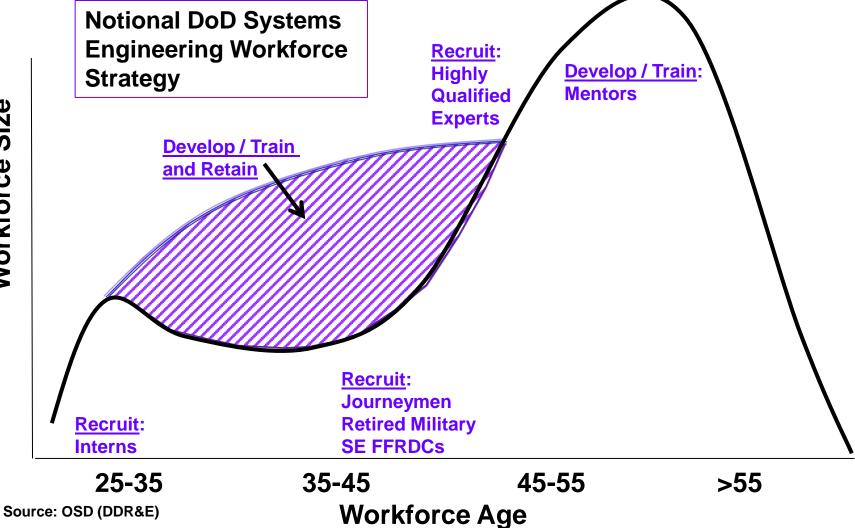


Carnegie Mellon

#### **External Forces**



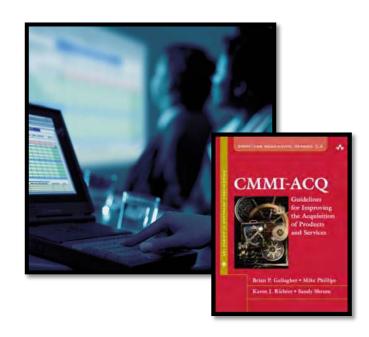
**Workforce Size** 



#### Reference Model



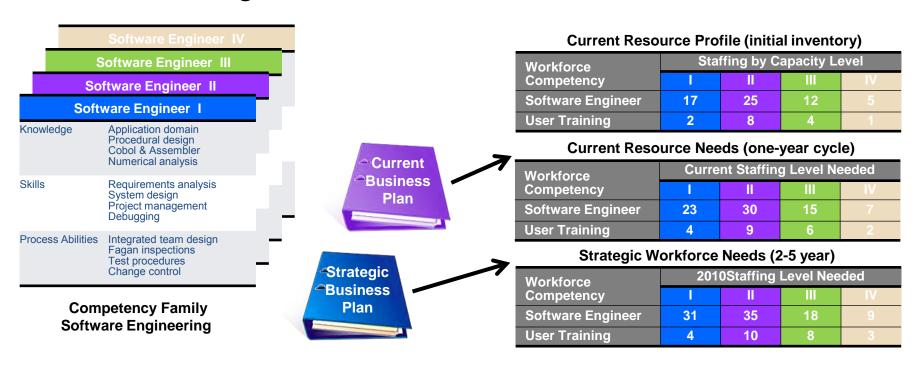
Evaluated client's acquisition training program components using Capability Maturity Model Integration® for Acquisition (CMMI® -ACQ) as reference model



## **Human Capital: Using Core Competencies**



+ Accurate identification of required competencies are important to support the curriculum review and development effort needed to ensure the best and most relevant training.



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## **Appraisals and CMMI Gotchas**

# Lessons in CMMI Use and Appraisal Preparation

Neil Potter
The Process Group
help@processgroup.com

Referenced articles are at www.processgroup.com/newsletter.htm



## **Agenda - Part 1**

- Introduction
- CMMI Premise
- Documentation
- Configuration Management
- Measurement and Analysis
- Supplier Agreement Management
- Project Planning
- Project Monitoring and Control



## **Agenda - Part 2**

- Integrated Project Management
- Training
- Equal-weighted Process Area practices?
- Appraisal Preparation PIIDing
- Appraisal Interview Preparation

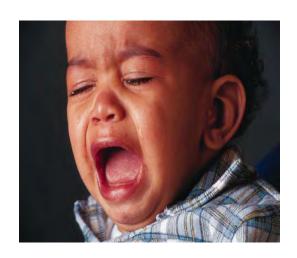


### **CMMI HAZARDS!**

#### Introduction

#### Using CMMI or preparing for an appraisal?

- Avoid the hazard of creating a paper factory, instead focus on organizational results
- Avoid putting the emphasis on the less important issues
  - » e.g., policy recital, training records, emails that say "We assigned this to Fred"
- Spend your time making things better, not on a rote exercise
- Know some common blind spots





## **CMMI Premise**

#### CMMI practices can:

- Reduce project risk
- Reduce rework and costs
- Improve output quality and predictability
- Improve productivity through process improvement and process reuse

#### CMMI:

- Can be used to diagnose current state
- Provides an example roadmap forward
  - » Management/project, engineering/organization, statistics/prediction, variation/mean



## **Hazard: Drowning in Documentation**

- Easy to fall into the trap of the paper factory
  - We are developers, so we develop!
  - What we really need is guidance for our jobs
    - » Capture best organization engineering and management practices
    - » Not necessarily repeat every book known to mankind!
- What problem are we trying to solve?
  - Make engineering easier, quicker, less hassle - NOT MORE



[Newsletter "documentation"]



## **Configuration Management (CM)**

### **Hazard: over-simplification**

- CM looks pretty straight forward, once people start to understand the discipline
- Don't avoid Configuration audits make them useful [SP 3.2]
  - Use physical audits to help ensure that products are released correctly, e.g.,
    - » Verify **differences** between source and release = change list
    - » Compare checksum value between source and release
- What problem(s) are we trying to solve?
  - Producing the right stuff and getting it to the customer
  - Keeping track of our stuff, protecting ourselves from loss

SP 3.2: Perform configuration audits to maintain integrity of the configuration baselines.



## **Measurement and Analysis (MA)**

Hazard: skip parts or overkill

- Organizations often have metrics but entirely skip the first half of this Process Area:
  - Defining: objectives, metrics, analysis, reporting, information storage
- Or take the other extreme and overdo measurement and goal definitions
  - 34 objectives, a procedure for documenting objectives, 82 core metrics
- Need a good balance for:
  - Spending enough time to arrive at appropriate goals
  - Specifying what measures are needed
  - Clarifying how they will be analyzed and stored
- What problem are we trying to solve?
  - Knowing why we are measuring in order to get the most value out of it and not waste time on useless metrics

[Newsletter "measurement"]



# **GP 2.8/3.2 and Over-simplified MA**Hazard: I measured it because CMMI SAID I HAD TO!



- MA comprises of only 7 PA measures, and GP 2.8 and 3.2 are academic
  - What is it telling you?
  - What problem are we trying to solve?
    - GP 2.8 (on each PA) How's it going this time?
    - GP 3.2 (on each PA) Are the PA related processes as implemented meeting our needs, getting better or worse?
    - MA should help you run your business, not just CMMI!

GP 2.8: Monitor and control the <x> process against the plan for performing the process and take appropriate corrective action.

GP 3.2: Collect work products, measures, measurement results, and improvement information derived from planning and performing the <x> process to support the future use and improvement of the organization's processes and process assets.



## **Project Planning (PP)**

#### Hazard: skimping on size estimation and risk management

- Many people either skip size, or don't spend enough time finding a good use for size or attribute estimation [SP 1.2]
  - "My project size is 2,000 hours"
  - "I estimate Lines of Code, but track effort"
- Others underutilize risk at the project level [SP 2.2]
  - Risks should come from the team, not just the manager
  - Risks should be more than boilerplate "We might not have resources"
  - Risks should be made very visible to customers + management
- What problem are we trying to solve?
  - Clarifying how big the project is
  - Understanding what can really go wrong
  - Thinking through potential issues ahead, while there is time to react / recover



SP 1.2 Establish and maintain estimates of the attributes of the work products and tasks. SP 2.2 Identify and analyze project risks.

[Newsletter "attributes"]



## **Project Monitoring and Control (PMC)**

Hazard: missing valuable information that could save the day

- · No useful way to track actual work progress [SP 1.1], e.g.,
  - Actual work effort (labor)
  - Actual amount of work accomplished (size)
- What problem are we trying to solve?
  - Use data to determine if current resource expenditure (hours or money) can be sustained
  - Know the volume of work and how much each project actually costs
    - » How much we lost this time, or how much future projects might cost
  - Proactively manage and identify re-planning points while there is time to recover
    - » Identifying large changes in effort or size

[Newsletter "attributes"]



## **Integrated Project Management (IPM)**

#### Hazard: not having proactive visibility

- Not use thresholds to trigger corrective action [SP 1.5]
  - At Level 3, corrective action and escalation are more <u>objective</u> ("We are 10% behind") than emotional ("I think things will speed up")
  - Organizational and project knowledge are used to establish thresholds
- Process tailoring not based on organizational learning [SP 1.1]
  - Level 3 is often interpreted as "Processes are standardized across all projects," rather than "Standard processes are tailored for each project"
- What problem are we trying to solve?
  - We have MEANINGFUL data, let's really use it!
  - Have organizational wisdom available and used

SP 1.5 Manage the project using the project plan, the other plans that affect the project, and the project's defined process.



# Integrated Project Management (IPM) Without Historical Data?

Hazard: databases full of data are not enough!

- Organizational Process Definition (OPD) and IPM not well understood
  - OPD sets up a Process Asset Library and measurement repository for use by projects (IPM)
  - Not all Lead appraisers know or communicate this
- What problem are we trying to solve?
  - Run projects based on historical and current data





## Do Software Engineers Need Training?

**Hazard: trivial training** 



#### Project Planning (Sp 2.5)

Make sure you have the skills for THIS project

#### Organizational Training

 Make sure you have the skills for current work, and work to come

#### What problem are we trying to solve?

- Engineers and managers don't have the skills to perform their roles correctly (as per process definition) and/or efficiently
- Prevent mistakes due to lack of skills



## Equal-weighted Process Area practices?

Hazard: each process area practice is treated as EQUAL

- Each CMMI practice should not necessarily be equally weighted during implementation. Example:
  - Policy vs. estimating effort or risk
  - Training records vs. performing validation
- The correct weighting can be given when you:
  - Focus on what you are trying to accomplish (real jobs)
  - Use the CMMI and its components to improve
  - Fix real problems
- What problem are we trying to solve?
  - Real world, day-to-day work gets better (easier, faster, higher) quality, less stress, less busy-work, less rework, less risk)



## **Appraisal Preparation - PIIDing\***

Hazard: creating documents to please the appraiser

- As an appraisal date approaches, people find themselves focused on providing required appraisal evidence:
  - A lot of time can be wasted chasing down documents
  - When practices are institutionalized correctly, the evidence needed already exists
- What problem are we trying to solve?
  - Evidence should never be created to please an appraiser
  - Artifacts examined should be the real work of the organization
  - For example, evidence of responsibilities could be an organization chart or a schedule with assignments

<sup>\*</sup>Practice Implementation Indicator



## **Appraisal Interview Preparation**

#### Hazard: wasting time rehearsing

- Some people prepare using mock interviews
  - Appraisals should be about how you DO YOUR REAL work
  - Interview practice might make folks feel more comfortable, but this can:
    - » Induce stress over remembering to say the right answers
    - » Focus your people on CMMI terms and rote answers
- What problem are we trying to solve?
  - Time to practice for an appraisal takes away from getting real work done
  - Participants should be able to answer the questions because the answers describe how they do their jobs



**Q & A** 

# **Additional Slides**



# Supplier Agreement Management (SAM)

Hazard: ill-advised avoidance

- A group might declare SAM Not Applicable:
  - They really do have a supplier, but are used to dealing with them
- Initially there are no suppliers
  - Then suppliers are added, but SAM is not invoked
- What problem(s) are we trying to solve?
  - Assessing and managing risks caused by suppliers
  - Establishing agreements and expectations for delivery
  - Providing visibility into supplier activities before it is too late



# **Maturity Level 4**

Hazard: having a metric or statistics wizard is enough

- Assume that if we can just find that one magic metric, we will be Level 4 (maybe even 5)
  - It's not really about a metric or two; it's about using statistical thinking to do your work!
- Assume that a metrics person can do all of Quantitative Project Management (QPM)
  - Allowing project managers to focus on their regular day-to-day tasks!
- What problem are we trying to solve?
  - Understand statistical variation and remove special causes
  - Run projects quantitatively and <u>sub processes statistically</u>
  - Base decisions on what we now know and predict ahead



## **Level 4 Without SPC?**

Hazard: numbers alone are not enough!

- Very specific words used in the model
  - Run projects quantitatively and <u>sub</u> <u>processes statistically</u>
    - » Understand statistical variation
    - » Remove special causes of variation
    - » Use some type of <u>SPC</u>
- What problem are we trying to solve?
  - Make business decisions based on calculated natural bounds
  - Use data to predict outcomes statistically

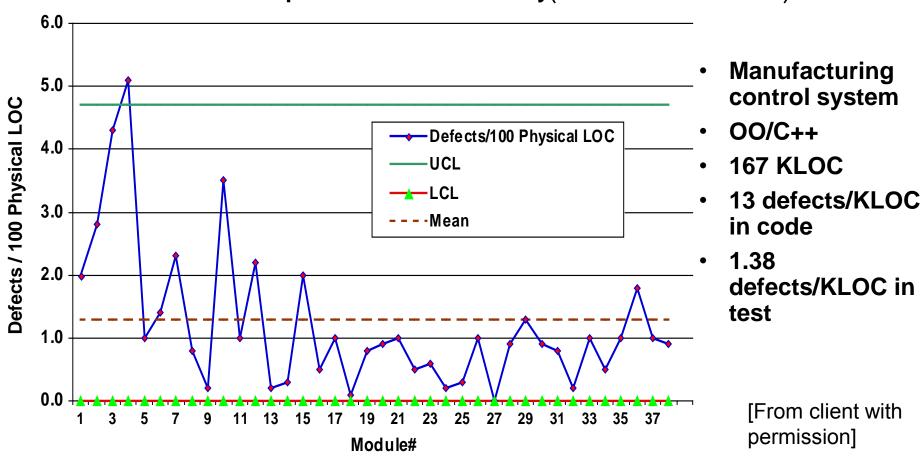






# **Code Quality Example**

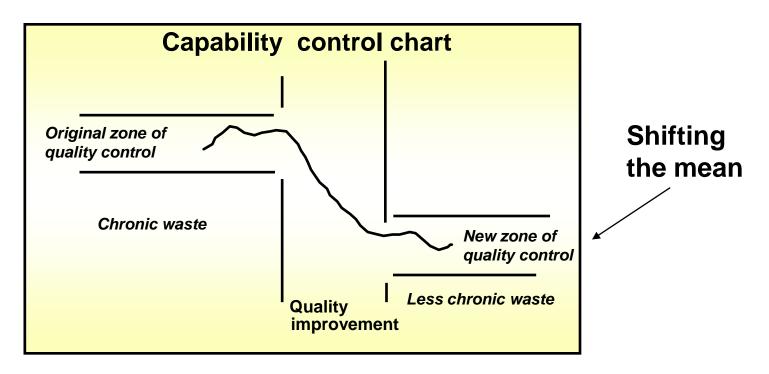
Code Inspection Defect Density(with trial control limits)





# **Maturity Level 5**

Hazard: not building on statistically stable (L4) processes



Continual improvement means measurably improving process capability in a controlled fashion.



# Maturity Level 5 (Cont.)

Hazard: not building on statistically stable (L4) processes

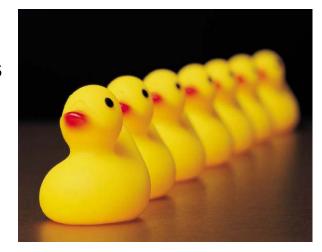
- It is easy to interpret Level 5 Process Areas as <u>qualitative</u>. You might think that:
  - Casual Analysis and Resolution (CAR) <u>could</u> consist of brainstorming causes
  - Organizational Innovation and Deployment (OID) <u>could</u> be mistaken for **qualitative** improvement
    - » Qualitative improvement is L3 Organizational Process Focus (OPF) and Organizational Process Definition (OPD)
- What problem are we trying to solve?
  - Level <u>4</u> is intended to collect and use data statistically for prediction, control and decisions. Level <u>5</u> practices build on that to:
    - » <u>Reduce variation</u> of selected sub processes (remove common causes of variation), AND / OR <u>shift the mean</u>



# **Maturity Level 4 and 5 Crack Down?**

Hazard: an SEI audit takes away your dreams of Level 4/5

- Some appraisers have been too generous
  - Did they NOT understand the Model?
  - Did they SELL a level?
- What to do now?
  - Re-educate people on the intent and details of Level 4/5?
  - Be harsh on lead appraisers now?
  - Take away levels?
- What problem are we trying to solve?
  - Devaluation of Level 4 and Level 5
    - "I have a vendor in <city X>. They say they are Level 5 but don't even act Level 2."





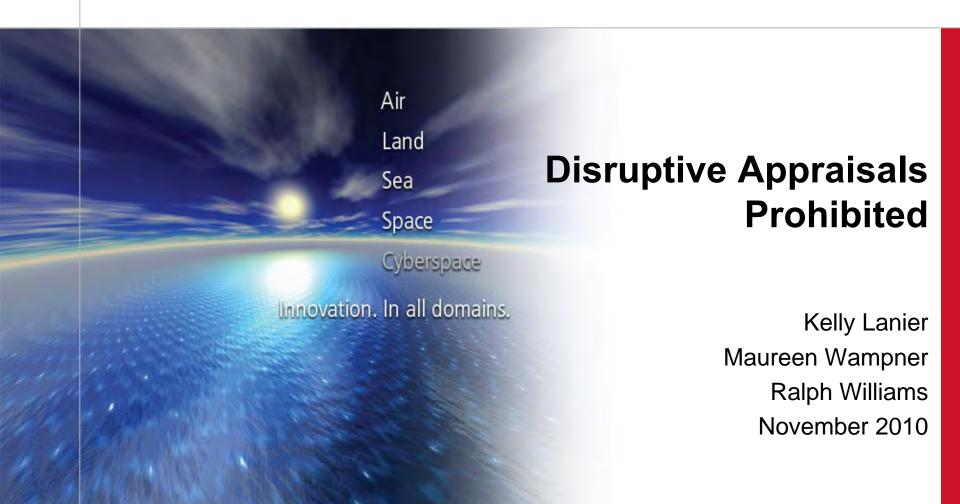
# **Buying a Level?**

### Hazard: doesn't help run your business

- What if you choose "easy" appraiser
  - Has your business improved?
  - Giving you credit for too much can:
    - » Build a poor foundation for the future
    - » Upset your customer(s) who now have higher expectations about your abilities
    - » Devalue the ratings
    - » Cause more audits
- What problem are we trying to solve?
  - Someone told us to be at a level, so we are looking for the quick path
  - CMMI intent is to set you on an improvement path, not to pass a test







## **Agenda**

- The Past
- How Did We Do It?
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### 2005-2007 Appraisal Metrics

| 2005 | Class C 1  | 7/25 - 7/29 |
|------|------------|-------------|
|      | Class C 2  | 9/27-9/29   |
|      | Class C 3  | 10/10-10/12 |
|      | Class C 4  | 11/14-11/16 |
|      | Class C 5  | 12/6-12/8   |
|      | Class C 6  | 12-Dec      |
| 2006 | Class C 7  | 1/16-1/18   |
|      | Class B 1  | 2/6-2/17    |
|      | Class C 8  | 4/4-4/5     |
|      | Class B 2  | 4/24-5/5    |
|      | Class B 3  | 7/10-7/21   |
|      | Class C 9  | 8/14-8/16   |
|      | Class B 4  | 9/11-10/13  |
| 2007 | Class C 10 | 1/3-1/5     |
|      | Class C 11 | 1/29-2/2    |
|      | Class C 12 | 2/14-2/15   |
|      | Class C 13 | 2/26-3/2    |
|      | Class C 14 | 4/2-4/6     |
|      | Readiness  |             |
|      | Review     | 4/30-5/1    |
|      | SCAMPI     | 5/7-6/1     |

| Task                              | 2005-2007 |  |
|-----------------------------------|-----------|--|
| CMMI Level                        | 5         |  |
| Regions                           | 5         |  |
| # SCAMPI Programs                 | 39        |  |
| # Artifacts in Evidence           | 10261     |  |
| # Class C Appraisals              | 14        |  |
| # Class B appraisals              | 4         |  |
| # Document Requests During SCAMPI | 207       |  |
| # SCAMPI Findings                 | 8         |  |
| Length of SCAMPI                  | 5 weeks   |  |

Set goal to reduce cost & program impact while sustaining CMMI Level 5

## **Agenda**

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#### **Baseline**

- NCS Common Process Architecture (CPA) is based on good Engineering practices
  - Not built around passing a CMMI appraisal
- Common Process Architecture execution is in place and remains stable
- Improvement priorities are based on strategic NCS business goals
  - Not driven by CMMI findings or CMMI compliance
  - Results deployed through NCS CPA



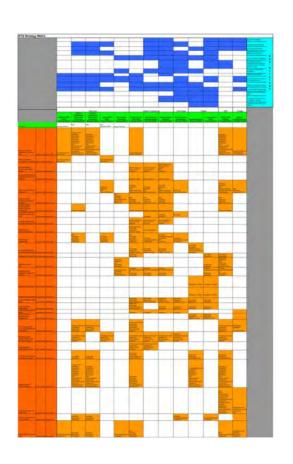
## **Process Ownership**

- Engineering Disciplines <u>took ownership of their own processes</u>
  - Process changes, questions, and issues go back to the owning discipline
  - Discipline Directors <u>sponsored organizational improvement projects</u>
- Removed traditional process group "crutches" to encourage programs accountability for process execution
  - Large regional process groups responsible for program process "stuff"
  - Measurement teams responsible for entering and analyzing program metrics
  - Tailoring teams responsible for CPA tailoring and program work instructions

# **Emphasis on Improving Program Execution**

Raytheon
Network Centric Systems

- Regional Engineering Process Groups replaced with <u>Engineering Execution Centers</u> focused on improving program execution
  - Provides "bottoms-up" improvement
- Improvement projects determined by NCS Business Strategy and Engineering Strategy elements
  - <u>Engineering and Technology Strategy Matrix</u>
  - Provides "top-down" systemic improvements
- Process Management became a background task with a small set of resources



Improvements tied to Business and Engineering goals

# Strengthened the Measurement Program



- Enabled Program accountability and ownership of their own metrics
- MEASUREthis!
- Leading Indicators Review with VPs
- Leading Indicator Deep Dives





## **Process Sustainment Monitoring**

- Interim CPA Checks (iCPAs)
  - Smaller, still frequent
  - An issue in one region is an issue in all regions
- Identified a common, smaller set of documents for evidence
  - Pareto Principle
- Identified and resolved issues early
  - Started immediately after 2007 SCAMPI-A
- Eliminated backslide



# Tailored the Appraisal Process and Mindset



- Set Appraisal Team expectations
  - Some level of discovery will be required
  - Expected to be able to determine if CMMI practices were implemented by evidence and affirmations provided without "extreme annotation"
- Reduced unique evidence artifacts collected and reviewed 10,000+ to 1,600
  - Higher number of artifacts used to be a badge of honor for appraisal teams
- Validated evidence with internal appraisal team members rather than using full appraisal team
- Deleted unnecessary briefings to the organization
  - Opening briefing, Draft Findings
  - Eliminated :90 per program participant

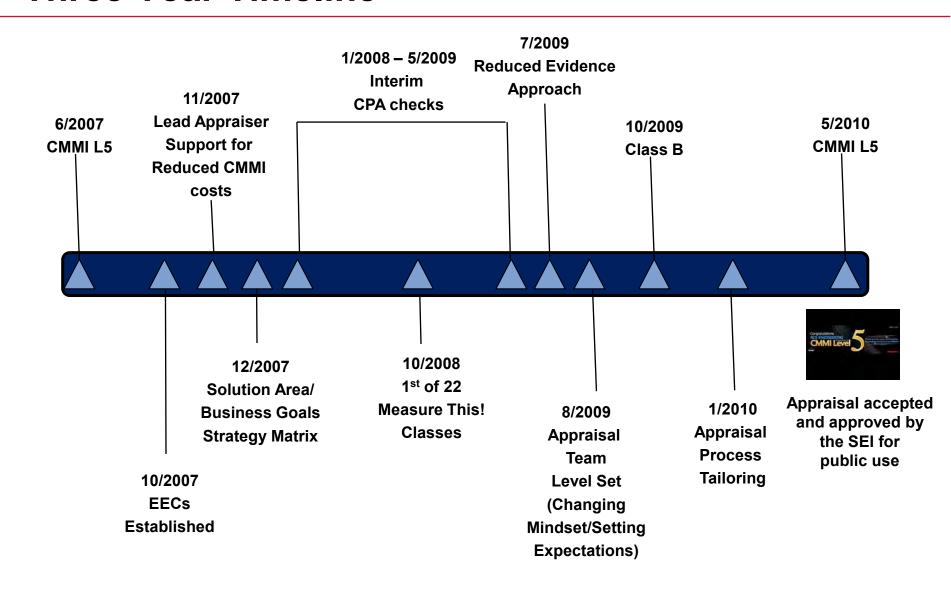
Easier for programs rather than easier for the appraisal team

# Tailored the Appraisal Process and Mindset



- Used "show and tell" format to allow programs to better explain their work
  - DOORS
  - Configuration Management Tools
  - Active Risk Manager
- Executed interviews in parallel using VTC
- Reduced full appraisal team review of appraisal evidence by 4 hours
  - Accepted Mini-Team "FI" recommendations
- Presented Final Findings via Netcast to allow appraisal participants to participate from their desks

#### **Three Year Timeline**



## **Agenda**

- The Past
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### **Appraisal Cost Comparison**

|      |            |             |      |         | _          |      |
|------|------------|-------------|------|---------|------------|------|
| 2005 | Class C 1  | 7/25 - 7/29 | 2008 | iCPA 1  | 4/7-4/18   |      |
|      | Class C 2  | 9/27-9/29   |      | iCPA 2  | 6/16-6/27  |      |
|      | Class C 3  | 10/10-10/12 |      | iCPA 3  | 7/28-8/8   |      |
|      | Class C 4  | 11/14-11/16 |      | iCPA 4  | 9/15-9/26  |      |
|      | Class C 5  | 12/6-12/8   |      | iCPA 5  | 12/1-12/12 |      |
|      | Class C 6  | 12-Dec      |      |         |            | -12% |
| 2006 | Class C 7  | 1/16-1/18   | 2009 | iCPA 6  | 3/2-3/6    |      |
|      | Class B 1  | 2/6-2/17    |      | iCPA 7  | 3/10-3/12  |      |
|      | Class C 8  | 4/4-4/5     |      | iCPA 8  | 5/4-5/8    |      |
|      | Class B 2  | 4/24-5/5    |      | iCPA 9  | 7/13-7/17  |      |
|      | Class B 3  | 7/10-7/21   |      |         |            |      |
|      | Class C 9  | 8/14-8/16   |      |         |            |      |
|      | Class B 4  | 9/11-10/13  |      | iCPA 9  | 7/13-7/17  | -59% |
| 2007 | Class C 10 | 1/3-1/5     | 2010 | Class B | 9/28-10/16 |      |
|      | Class C 11 | 1/29-2/2    |      | Review  | 3/10-3/11  |      |
|      | Class C 12 | 2/14-2/15   |      | SCAMPI  | 5/3-5/14   |      |
|      | Class C 13 | 2/26-3/2    |      |         |            |      |
|      | Class C 14 | 4/2-4/6     |      |         |            |      |
|      | Readiness  |             |      |         |            |      |
|      | Review     | 4/30-5/1    |      |         |            |      |
|      | SCAMPI     | 5/7-6/1     |      |         |            | -76% |

**Achieved 62% Reduction in Cost in 2010** 



## **Measureable Improvements**

|                         | 2007    | 2010        |  |
|-------------------------|---------|-------------|--|
| CMMI Level              | 5       | 5           |  |
| Regions                 | 5       | 5+Satellite |  |
| # SCAMPI Programs       | 39      | 21          |  |
| # Artifacts in Evidence | 10261   | 1596        |  |
| # Class C Appraisals    | 14      | 9           |  |
| # Class B appraisals    | 4       | 1           |  |
| # Document Requests     |         |             |  |
| During SCAMPI           | 207     | 21          |  |
| # SCAMPI Findings       | 8       | 0           |  |
| Length of SCAMPI        | 5 weeks | 8.5 days    |  |

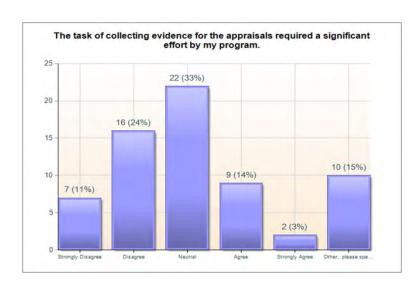
84%
Evidence
Reduction

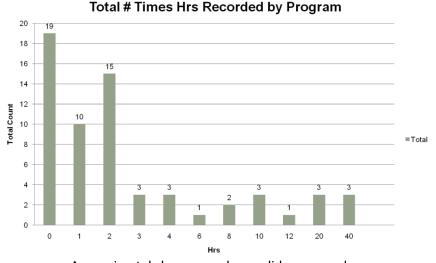
75% Fewer Class Bs



## **Reduction in Program Impact**

- "The appraisal approach you guys took this time around was much less stressful on our program"
- "I had heard that being an appraisal program was a lot of work, but it hasn't been a big deal at all"
- "I didn't have any program managers yelling at me about the appraisal impact this time around"
- "I didn't even realize we were having an appraisal"





Approximately how many hours did you spend on Collecting evidence for the appraisal?

Quotes and survey results from the programs



## **Agenda**

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#### The Future

- We will use this approach for all future appraisals
- Business standards of program execution naturally result in success without employing disruptive efforts to prepare for and conduct appraisals

## **Agenda**

- The Past
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## **Summary**

- CPA execution remained stable after the 2007 SCAMPI A
- Focused on improving program execution rather than achieving CMMI Level 5
  - Emphasis on managing with metrics
  - Discipline and program ownership
  - Process not separate from program execution
- Partnered with our lead appraiser to tailor the appraisal process to be as minimally invasive and cost effective as possible
- Changed appraisal mindset to minimize impact on programs

# GENERAL DYNAMICS Land Systems

Put Your Defect Data to Work: Using Process Performance Models and Root Cause & Corrective Action

Margaret Corr Dawn Jaskolski David Sobetski, PMP

November 17, 2010

# **Agenda**

- GDLS Overview
- Software Quality System Overview
- Peer Review and Software Problem Reporting Tools
- Defect Containment Effectiveness Model (DCE)
- Process Performance Models (PPM)
- Process Performance Baselines (PPB)
- Root Cause and Corrective Action (RCCA)
- Benefits & Challenges

# **Land Systems Products**

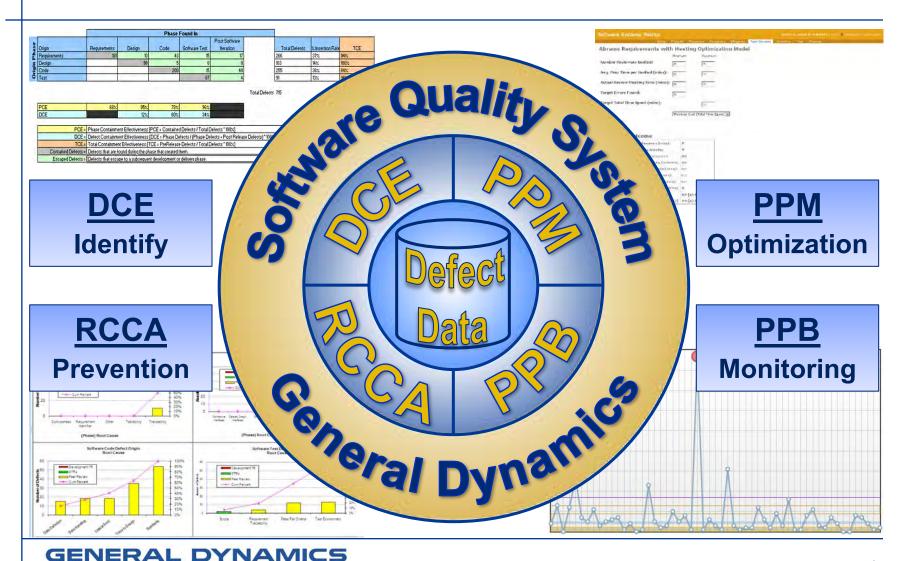








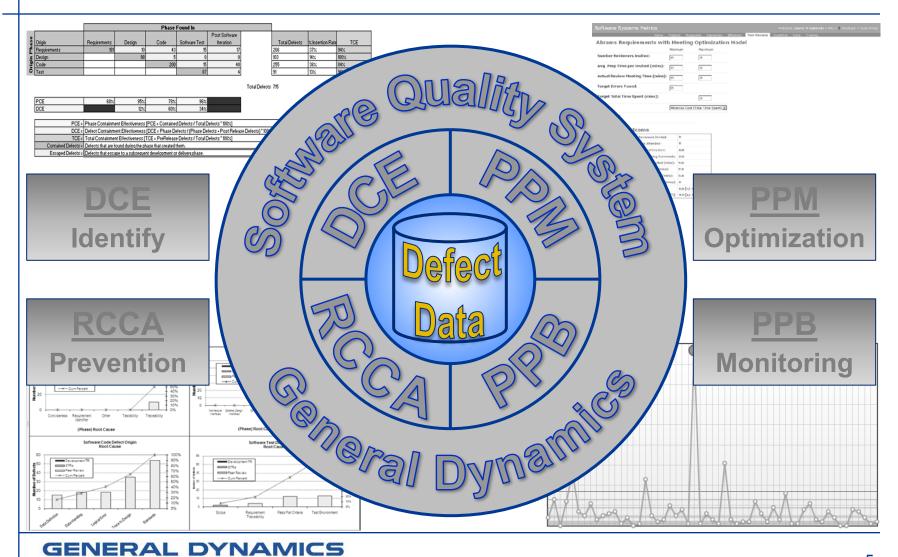
# **Software Quality System Overview**



Land Systems

## **Defect Data**

Land Systems



## **Defect Data**

- Defect Origin
- Root Cause
- Defect Severity
- Peer Review Data
- Software Problem Reporting Data

## **Defect Origin and Root Cause**

#### The Root Cause

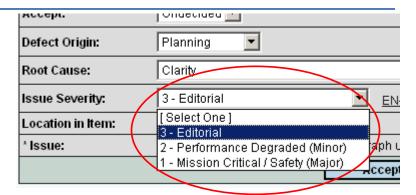
- Selection changes based upon the Defect Origin selected.
- Chosen based on what is determined to be the root cause of the problem and where it originated (Defect Origin).
- Not applicable for editorial issues.

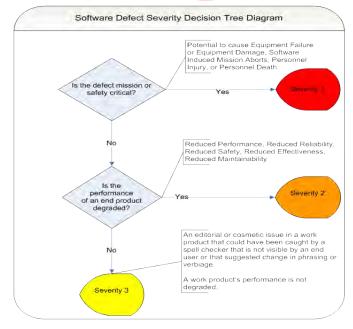
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| Issue Category (Defect Origin) | Root Cause                              |
|--------------------------------|---|
| Planning                       | Clarity Completeness                    |
|                                | Scope Change Per Higher Level Documents |
|                                | Trace to Higher Level Documents         |
|                                | Trace to Fligher Level Documents        |
| Requirements                   | Ambiguity                               |
| Tro quil official              | Testability                             |
|                                | Traceability                            |
|                                |   |
| Design                         | Architecture                            |
|                                | Detailed Design                         |
|                                | Interfaces                              |
|                                | Traceability                            |
|                                |   |
| Code                           | Data Definition                         |
|                                | Data Handling                           |
|                                | Initialization                          |
|                                | Logical Error                           |
|                                | Standards                               |
|                                | Trace to Design                         |
| T                              | Description in the                      |
| Test                           | Pass/Fail Criteria                      |
|                                | Requirement Traceability                |
|                                | Test Environment                        |
|                                | Scope                                   |

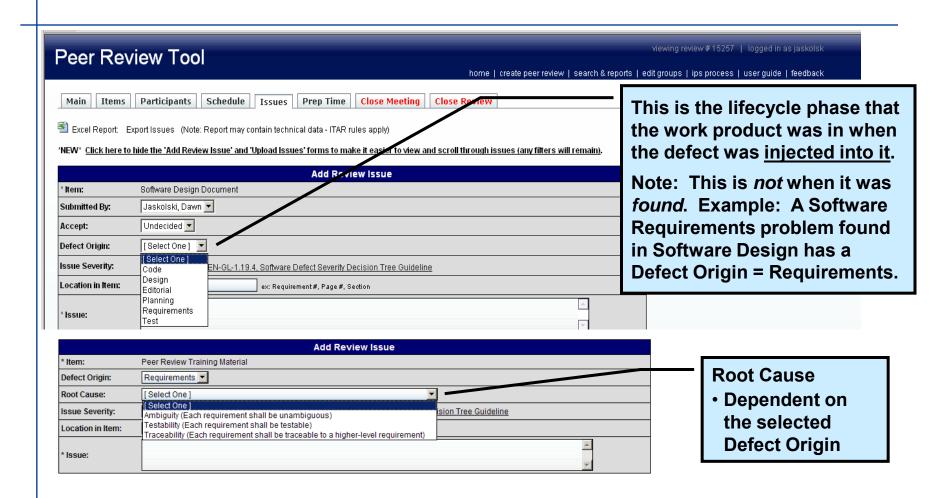
# **Defect Severity**

- It is important to categorize the severity of the issue correctly. This categorization helps the project and organization identify where process, tool, and training improvements are needed.
- Major and Minor issues, Severity 1 and 2 respectively, are considered technical defects that generally require further analysis and prevention measures.
- Editorial issues, Severity 3, are considered non-technical defect and are not used in the generation of project defect prevention metrics.





### **Peer Review Tool**



Land Systems

# **Software Problem Reporting Tool**

#### Severity Phase Found In Safety/Mission This is the lifecycle Critical phase that the Performance Issue Type: work product was Date Created: Originator: **Degraded** 2010-10-15 08:09:29 CORR. M. in when the defect Problem Type: Performance NOT 2. Performance Degraded REVIEW/ANALYSIS was identified or **Degraded** Phase Found In: Version Identified In: Version Injected In: found Independent Software Test [Select One] \*REQUIRED if Phase Found In = "Other Field" Related System Requirement: Regression Problem: Test Name: Responsible Engineer: Test Engineer: CORR, S. CORR, M. Root Cause: Requirements -[Select One] Requirements Standard **Defect Origin** Select Onel **Root Cause** \*REQUIRED if Root Cause This is the lifecycle Traceability Based on the phase that the defect origin. Issue Title: work product was Demonstration CMMI - San Identifies the root in when the defect cause of the defect was injected into it

### **Defect Data – Benefits and Challenges**

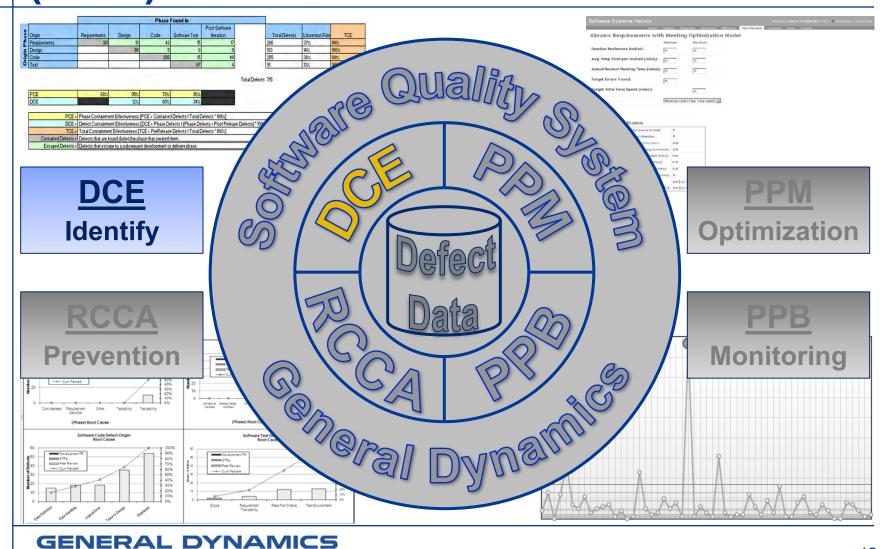
#### Benefits:

- Automation
  - Tools enforce a more consistent process
  - Simpler data collection
  - Real-time metrics
- Consistent data between the Peer Review and Problem Reporting Tools
- Guidelines and Help linked into the tools for easy access

#### Challenges:

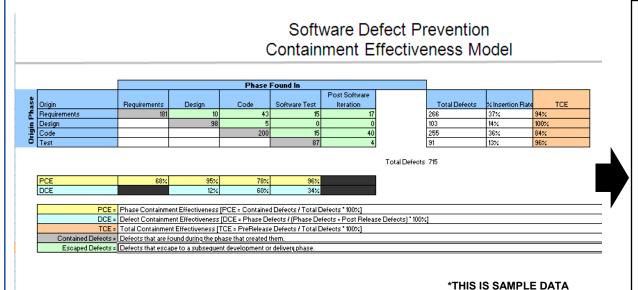
- Data Integrity
  - Consistently identifying defect severities between technical and editorial
  - Size data is often entered incorrectly
  - Root cause data is often inconsistent
- Identifying definitions for root causes
- Z Educating employees on definitions

# Defect Containment Effectiveness (DCE) Model



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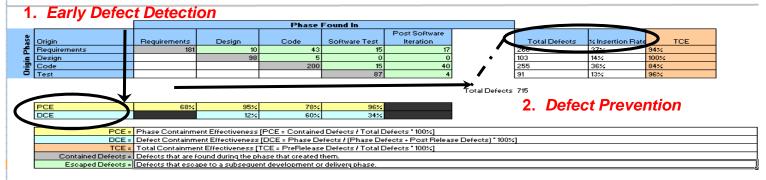
# DCE Model - Introduction and Definitions



- Phase Containment
   <u>Effectiveness (PCE):</u>
   tracks the ability of each
   phase to find defects
   before they escape that
   phase
- Defect Containment
   <u>Effectiveness (DCE):</u>
   tracks the ability of each
   phase to find defects
   passed to it by upstream
   phases
- Total Containment
   <u>Effectiveness (TCE):</u>
   tracks the ability of the
   project to find defects
   before they are released
   (post-release)
- Source data is Major and Minor defects collected from the peer review database and problem reporting database
- Phase Defects: The defects that were found in a specified software development lifecycle phase
- Post Release Defects: The defects that were found in a phase outside of the software development lifecycle phase
- <u>PreRelease Defects</u>: Defects that were found in a software development lifecycle phase in the current software version

### **DCE Model - Goals**

#### Software Defect Prevention Containment Effectiveness Model



\*THIS IS SAMPLE DATA

#### **Goals of the Model:**

- 1. Early Defect Detection
  - · Increase the number of defects found within the phase they originated in
    - Phase Containment Effectiveness (PCE)
  - Reduce the number of defects escaping to later development phases
    - Defect Containment Effectiveness (DCE)
- 2. Defect Prevention
  - Reduce total number of defects originating within a specific phase
    - > Total Defects
    - % Insertion Rate

#### **GENERAL DYNAMICS**

# DCE Model - Usage

#### When Used:

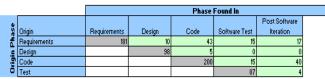
Data collection and analysis occurs after a software release

#### **Used For:**

- Identifying organizational process and technology improvement needs
- Planning of subsequent product release(s)
  - Consider if a significant number of defects are detected in any particular life cycle phase
  - Ensure common causes of defects within a phase or phases have been identified and actions to further investigate causes of defects are assigned and tracked to completion
  - Understand the implications of not addressing the common causes of defects
  - Ensure implementation of preventive corrective actions (e.g. notify developers of common defects, increase focus on suspect or problem areas)

## DCE Model – Analysis Examples

### Software Defect Prevention Containment Effectiveness Model



| Total Defects | % Insertion Rate | TCE  |
|---------------|------------------|------|
| 266           | 37%              | 94%  |
| 103           | 14%              | 100% |
| 255           | 36%              | 84%  |
| 91            | 13%              | 96%  |

Total Defects 715

| PCE | 68% | 95% | 78% | 96% |  |
|-----|-----|-----|-----|-----|--|
| DCE |     | 12% | 60% | 34% |  |

| PCE               | Phase Containment Effectiveness [PCE = Contained Defects / Total Defects * 100%]                         |
|-------------------|--|
| DCE               | ■ Defect Containment Effectiveness [DCE = Phase Defects / (Phase Defects + Post Release Defects) * 100%] |
| TCE               | Total Containment Effectiveness [TCE = PreRelease Defects / Total Defects * 100%]                        |
| Contained Defects | Defects that are found during the phase that created them.   |
| Escaped Defects   | Defects that escape to a subsequent development or delivery phase.                                       |

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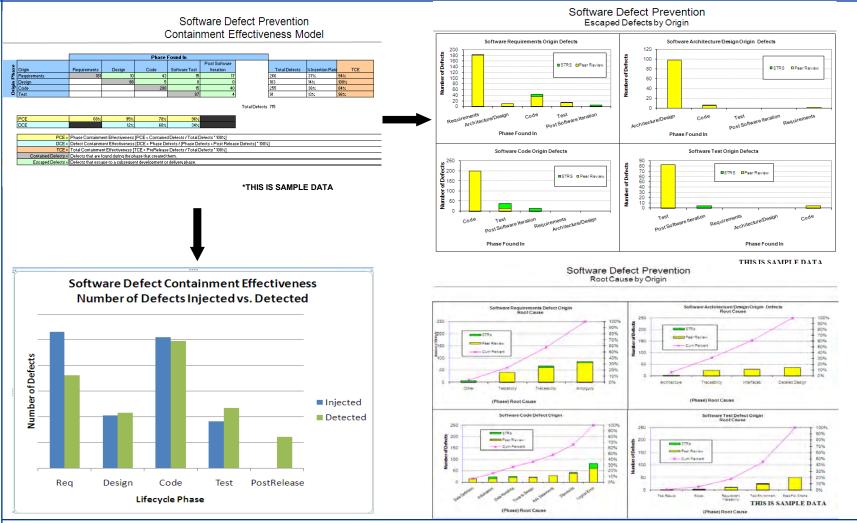
Is the number of post release defects significantly higher than expected?

Is the number of post release defects significantly lower than expected?

What is the phase with the lowest PCE percentage? Consider how early in the life cycle this phase is.

How does the PCE, DCE and TCE compare to the last release or other projects?

# Defect Containment Effectiveness Model Considerations for Analysis



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### DCE Model – Benefits and Challenges

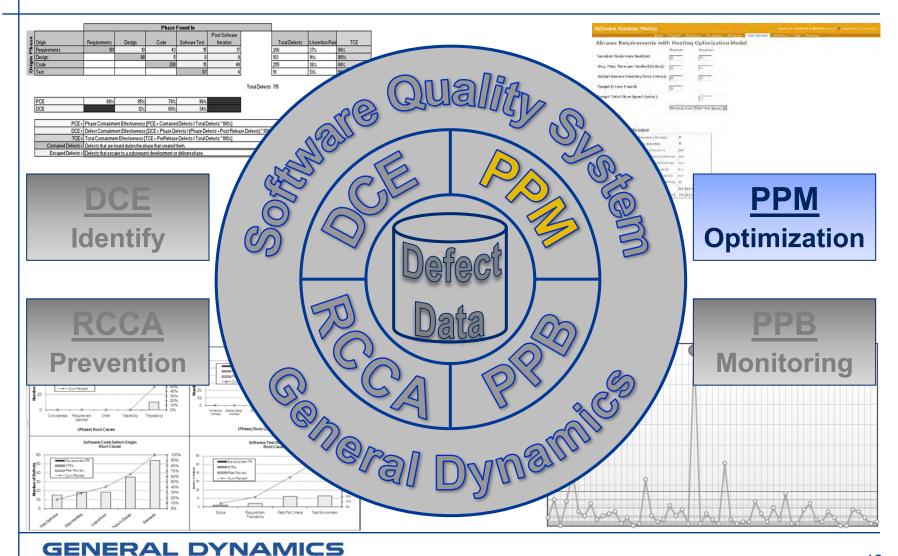
#### Benefits

- One model that can be used as a basis of identifying areas for both early defect detection and defect prevention
- Provides an overall view of a project's quality with many ways to slice and dice the data
- Similar project data can be rolled up as appropriate

### Challenges

- The model can be complex to understand, so time is needed to educate users
- Formula variables need to be well defined and understood before generating the model
- Shows the macro view of defects, so a change in the model cannot directly be linked to a specific improvement
  - Not measuring a subprocess

## **Process Performance Models (PPM)**



Land Systems

## **PPM – Early Defect Detection**

# Software Defect Prevention Containment Effectiveness Model

|    |              |              |        | Phase | Found In      |               |
|----|--------------|--------------|--------|-------|---------------|---------------|
| ā. |              |              |        |       |               | Post Software |
| Š  | Origin       | Requirements | Design | Code  | Software Test | Iteration     |
| £  | Requirements | 181          | 10     | 43    | 15            | 17            |
| 3  | Design       |              | 98     | 5     | 0             | 0             |
| ē  | Code         |              |        | 200   | 15            | 40            |
| ō  | Test         |              |        |       | 87            | 4             |

| Total Defects | % Insertion Rate | TCE  |
|---------------|------------------|------|
| 266           | 37%              | 94%  |
| 103           | 14%              | 100% |
| 255           | 36%              | 84%  |
| 91            | 13%              | 96%  |

Total Defects 715

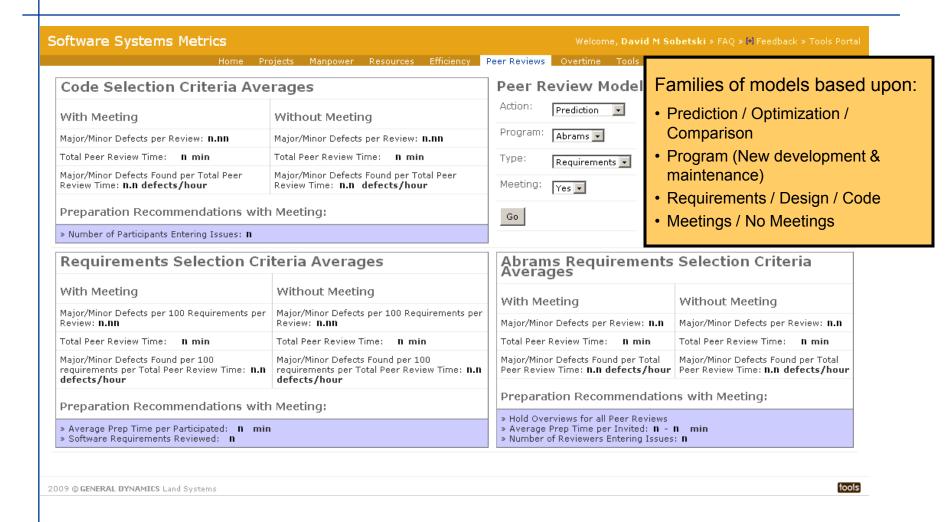
| PCE | 68% | 95% | 78% | 96% |  |
|-----|-----|-----|-----|-----|--|
| DCE | 7   | 12% | 60% | 34% |  |
|     |     |     |     |     |  |

| PCE:                | Phase Containment Effectiveness [PCE = Contained Defects / Total Defects * 100%]                      |
|---------------------|---|
| DCE =               | Defect Containment Effectivenes LDCE = Phase Defects / (Phase Defects + Post Release Defects) * 100%] |
| TCE =               | Total Containment Effectiveness [TCE: PreRelease Defects / Total Defects ' 100%]                      |
| Contained Defects = | Defects that are found during the phase that seated them.   |
| Escaped Defects =   | Defects that escape to a subsequent development or delivery phase.                                    |

\*THIS IS SAMPLE DATA

Peer Review Process Performance Models were first created for Requirements in order to improve the Requirements PCE through Early Defect Detection

## **Software Metrics Tool – PPM Main Page**



## **PPM Tool – Prediction**

| Software Systems Metrics                |                   |                        |            |              |            | David M Sobetski » FAQ » M Feedback » Tools Por |
|---|-------------------|------------------------|------------|--------------|------------|---|
| Home                                    | e Projects Manpov | er Resources           | Efficiency | Peer Reviews | Overtime T | Fools Training                                  |
| Abrams Requirements w                   | rith Meeting F    | rediction <sup>·</sup> | Tool       |              |            |   |
| Estimated Number of Reviewers I         | nvited:           |                        |            |              |            |   |
| Estimated Avg. Prep Time per Inv        | ited (mins): n    |                        |            | User         | can ent    | er the tool on their                            |
| Estimated Review Meeting Time (         | mins):            |                        |            |              |            | tomatically routed                              |
| Predict                                 |                   |                        |            | here a       | at the st  | tart of a peer review.                          |
| Predictions                             |                   |                        |            | User         | can pre    | dict peer review                                |
| Number of Reviewers Attended:           | n.n               |                        |            | result       | ts based   | d upon number of                                |
| Number of Reviewers Participated:       | n.n               |                        |            |              |            | vited, preparation time                         |
| Number of Reviewers Making Comments:    | n.n               |                        |            |              |            |   |
| Avg. Prep Time per Attended (mins):     | n.n               |                        |            | spent        | by the     | reviewers, and                                  |
| Avg. Prep Time per Participated (mins): | n.n               |                        |            | meeti        | ng time    |   |
| Technical Errors [95% CI]:              | n.n [+/- n.n]     |                        |            |              |            |   |
| Total Peer Review Time (mins) [95% CI]: | n.n [+/- n.n]     |                        |            |              |            |   |

2009  $\otimes$  **GENERAL DYNAMICS** Land Systems



# **PPM Tool – Optimize Time**

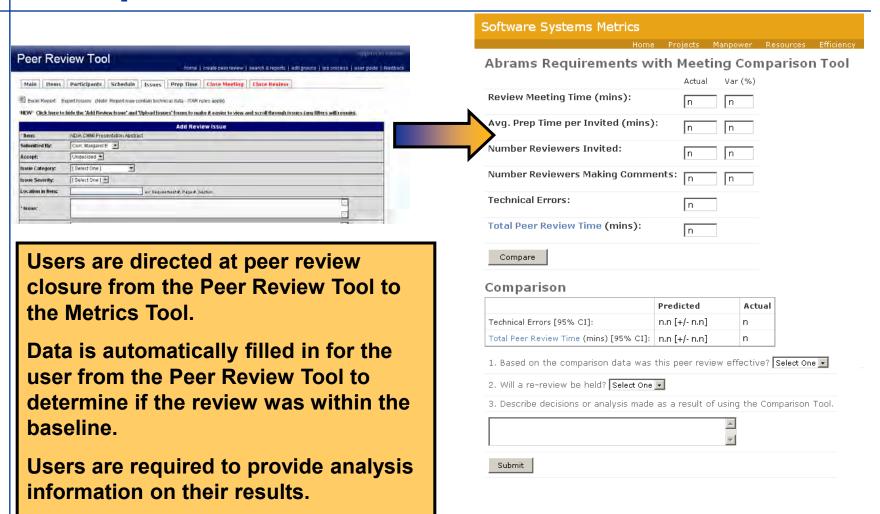
**GENERAL DYNAMICS** 

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| oftware Systems Metrics  |   |               |           |            |              |          |       | d M Sobetski » FAQ » | H Feedback » To |  |
|--|---|---------------|-----------|------------|--------------|----------|-------|----------------------|-----------------|--|
| Home   | Projects                                | Manpower      | Resources | Efficiency | Peer Reviews | Overtime | Tools | Training             |                 |  |
| brams Requirements wit   | h Meet                                  | ing Op        | timizatio | on Mode    | ıl.          |          |       |                      |                 |  |
| •  | Minimum                                 |               | ximum     |            |              |          |       |                      |                 |  |
| Number Reviewers Invited:  | n                                       | In            |           |            |              |          |       |                      |                 |  |
| tug Duan Time non Invited (mins)   |   |               |           |            |              |          |       |                      |                 |  |
| Avg. Prep Time per Invited (mins):   | n                                       | n             |           |            |              |          |       |                      |                 |  |
| Actual Review Meeting Time (mins):   | n                                       | n             |           |            |              |          |       |                      |                 |  |
| Target Errors Found:   | n                                       |               |           |            |              |          |       |                      |                 |  |
|  | 111                                     |               |           |            |              |          |       |                      |                 |  |
| ·  |   | [             |           |            |              |          |       |                      |                 |  |
| arget Total Time Spent (mins):   |   | n             |           |            |              |          |       |                      |                 |  |
| Farget Total Time Spent (mins):  Goal:   | Maximiz                                 | e Errors Fou  |           | v          |              |          |       |                      |                 |  |
| - ' ' '  | Maximiz                                 |               |           | Ī          |              |          |       |                      |                 |  |
| Goal: Optimize Optimized Outcome   | ,                                       |               |           | v          |              |          |       |                      |                 |  |
| Optimize  Optimized Outcome Recommended Number of Reviewers Invited:   | n                                       |               |           | •          |              |          |       |                      |                 |  |
| Optimized Outcome Recommended Number of Reviewers Invited: Expected Number of Reviewers Attended:  | n<br>n                                  | e Errors Foui |           | •          |              |          |       |                      |                 |  |
| Optimized Outcome Recommended Number of Reviewers Invited: Expected Number of Reviewers Participated:  | n<br>n<br>n                             | e Errors Foui |           | •          |              |          |       |                      |                 |  |
| Optimize  Optimized Outcome  Recommended Number of Reviewers Invited: Expected Number of Reviewers Attended: Expected Number of Reviewers Participated: Expected Number of Reviewers Making Comm   | n<br>n<br>n.n                           | e Errors Foul |           | •          |              |          |       |                      |                 |  |
| Optimized Outcome Recommended Number of Reviewers Invited: Expected Number of Reviewers Attended: Expected Number of Reviewers Participated: Expected Number of Reviewers Making Committee | n<br>n<br>n.n<br>nents: n.n             | e Errors Foul |           | •          |              |          |       |                      |                 |  |
| Optimized Outcome Recommended Number of Reviewers Invited: Expected Number of Reviewers Attended: Expected Number of Reviewers Participated: Expected Number of Reviewers Making Comm Recommended Avg. Prep Time per Invited (mexpected Avg. Prep Time per Attended (mins)   | n n n.nnents: n.nnins): n.n             | e Errors Foui |           | •          |              |          |       |                      |                 |  |
| Optimized Outcome Recommended Number of Reviewers Invited: Expected Number of Reviewers Participated:  | n n n.nnents: n.nnins): n.nn            | e Errors Foui |           |            |              |          |       |                      |                 |  |
| Optimized Outcome Recommended Number of Reviewers Invited: Expected Number of Reviewers Attended: Expected Number of Reviewers Participated: Expected Number of Reviewers Making Comm Recommended Avg. Prep Time per Invited (miss) Expected Avg. Prep Time per Participated (miss)  | n n n.nneents: n.nnins): n.nnents: n.nn | e Errors Foui |           |            |              |          |       |                      |                 |  |

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# PPM Tool – Post Peer Review Comparison



# **PPM – Benefits and Challenges**

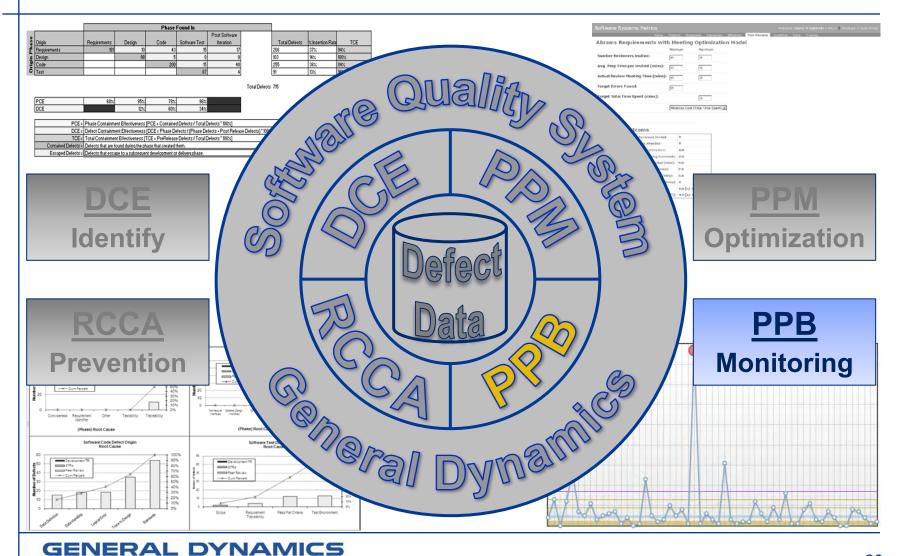
#### Benefits

- Optimize resource utilization
- Better able to predict future project performance
- PPM improvements returned as high as 400% increase in technical defect detection
- Exceeded our defect Phase Containment Effectiveness (PCE) goal of 90%.

### Challenges

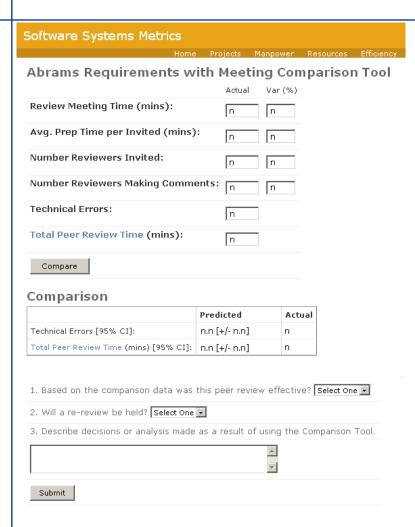
- → PPM Model usage
  - Making it user-friendly and easily accessible
  - Documenting usage
- Stakeholder buy-in
- A Keeping it from being personal, i.e. measuring the process & product and not the person performing the work
- Ensuring data integrity in the models

### **Process Performance Baselines (PPB)**



Land Systems

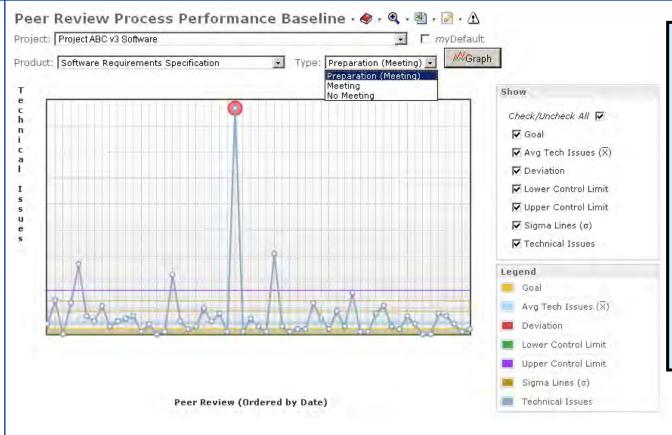
# Process Performance Baselines (PPBs) – Using PPM Tool Post Peer Review Comparison Analysis



Data is automatically provided to the PPBs when the peer review is completed.

Users provide analysis information on their results. Special causes of variation can be identified and explained at the time the data was created.

### **PPBs – Automated Metrics**

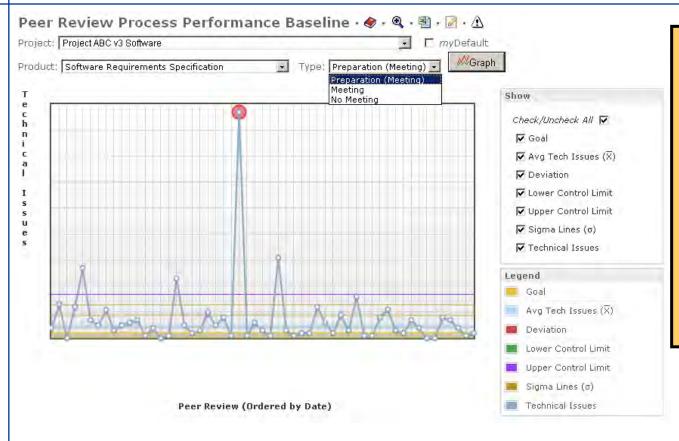


Statistical Process Control charts are generated live from Peer Review Data

#### User selects

- Project
- Work product type
- Meeting information
- Technical Defects or Cost (hours)
- Properties to display

# **PPBs – Analysis**



#### **Analysis**

- Look for special cause variation
- Monitor for trends, shifts or drifts that may highlight process changes
- Determine if rereview should be performed

## **PPBs – Benefits and Challenges**

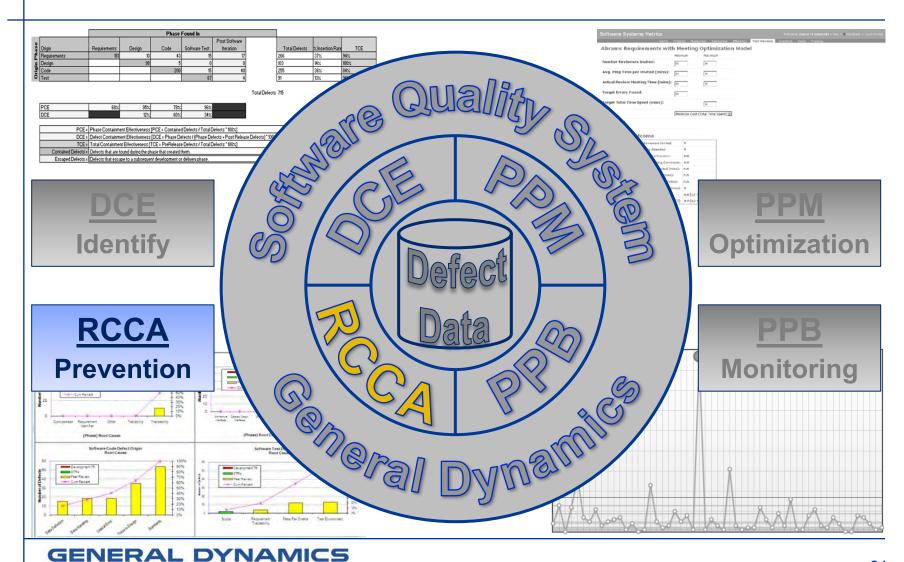
#### Benefits

- Peer reviews automatically feed PPBs
- Control charts are automated to generate from live peer review data
- Process is monitored to ensure process is performing as expected
- Quickly deal with process deviations
- Special causes of variation can be identified and documented as they occur

### Challenges

- Zero Educating employees on the use of the PPBs
- Determining when to set new process baselines
- Determining where to segregate the data
- Ensuring data integrity
- Upkeep of statistical data (UCL, Mean, Std Dev)

### **Root Cause & Corrective Actions**

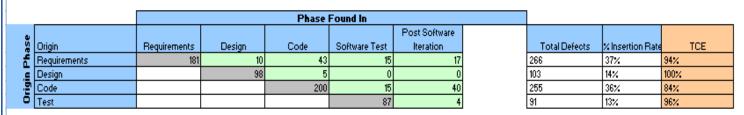


Land Systems

# Root Cause and Corrective Action (RCCA) – Defect Prevention Using the DCE Model

- Considerations for analysis
  - Common Cause Defects
  - Critical Defects

Software Defect Prevention
Containment Effectiveness Model



Total Defects 715

| PCE  | 68%            | 30%               | 18%              | 36%                 |                  |
|------|----------------|-------------------|------------------|---------------------|------------------|
| DCE  |                | 12%               | 60%              | 34%                 |                  |
|      |                |                   |                  |                     |                  |
| PCF- | Phace Containm | ant Effactivanace | IPCE - Container | l Defects J Total D | Defeate * 100*/1 |

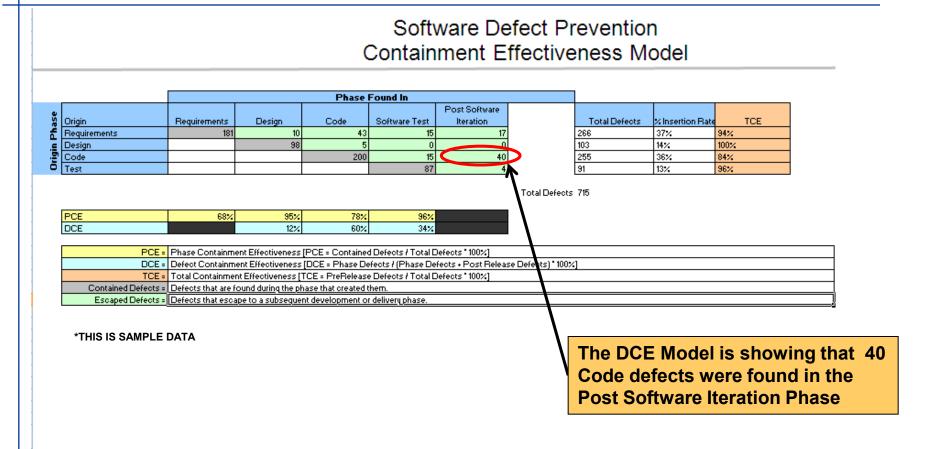
| PCE:                | Phase Containment Effectiveness [PCE = Contained Defects / Total Defects * 100%]                       |
|---------------------|--|
| DCE =               | Defect Containment Effectiveness [DCE = Phase Defects / (Phase Defects + Post Release Defects) * 100%] |
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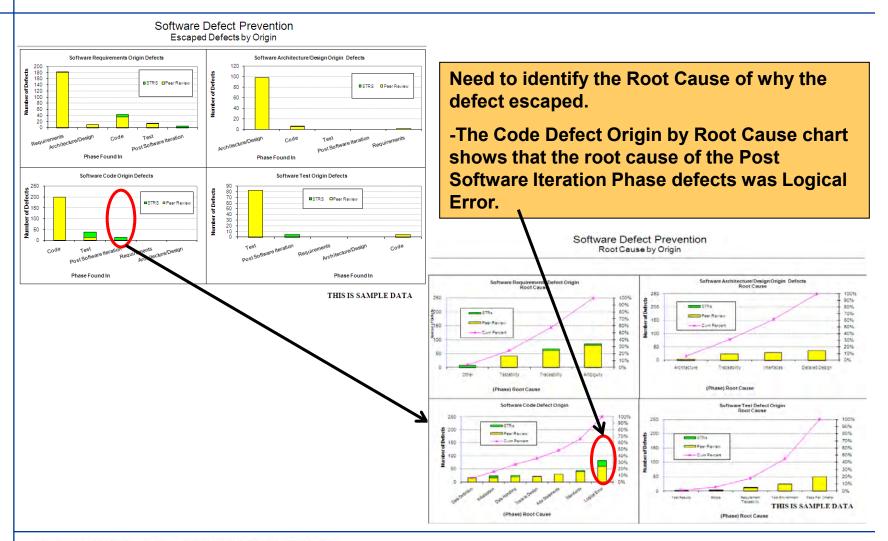
# Root Cause and Corrective Action (RCCA) – Steps For Performing RCCA

- 1. Identify a Problem
- 2. Defect Root Cause Analysis
- 3. Fishbone Analysis
- 4. Identify Corrective Actions
- 5. Verify Corrective Actions

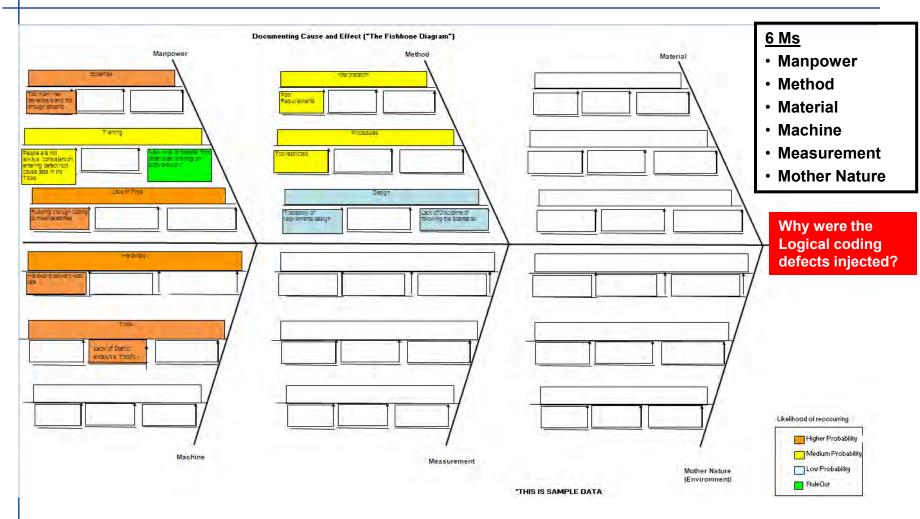
# Root Cause and Corrective Action (RCCA) Step 1: Identify a Problem - Example



# Root Cause and Corrective Action (RCCA) – Step 2: Defect Root Cause Analysis - Example



# Root Cause and Corrective Action – Step 3: Fishbone Analysis - Example



# Root Cause and Corrective Action – Step 4: Identify Corrective Actions - Example

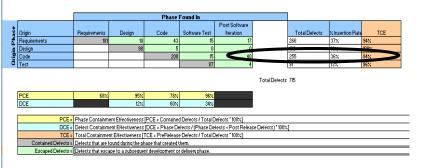
| Root Cause: (*usually High Probability)        | Corrective Action:   |
|--|--|
| Too many new developers and not enough experts | Add a review of the resource allocation plan                                   |
| Rushing through coding to meet deadlines       | Need to plan more time for peer reviews  |
| Incomplete requirements                        | Pilot agile development methods  |
| Lack of static analysis tool(s)                | Allocate effort and budget to identifying and purchase static analysis tool(s) |

\*THIS IS SAMPLE DATA

# Root Cause and Corrective Action – Step 5: Verify Corrective Actions - Example

#### **Before:**

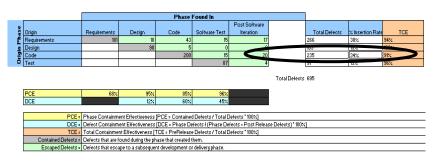
Software Defect Prevention
Containment Effectiveness Model



\*THIS IS SAMPLE DATA

#### **After:**

Software Defect Prevention Containment Effectiveness Model



\*THIS IS SAMPLE DATA

- This model alone cannot be used to verify the results of the corrective action implemented.
- PPBs need to be created/modified at the sub-process level

# Root Cause & Corrective Actions – Benefits and Challenges

#### Benefits

- Able to eliminate defects and make process improvements to prevent reoccurrence
- DCE Model showing fewer total defects and lower insertion rates

### Challenges

- Focusing on prevention versus a correction
- New methods require training
- Identifying where the best return on investment is
- Maintaining the scope of the effort
- Z Ensuring involvement of SMEs

## **Challenges**

- Stakeholder buy-in
  - Understanding the intent and purpose of the quality system
    - Getting past, "Why do I have to do this?"
  - Reeping it from being personal, i.e. measuring the processes & products and not the person performing the work
- Data Integrity
  - → Trusting the data
- Documenting savings / cost benefit

### **What Worked Well**

### Automation – keep it simple

- ¬ Web-based tools (easy access)
- Automation leads to data and process consistency
- Users able to focus on products, not process

#### Communication and education

- Strong and repeated communication with users
- Educating key stakeholders on the quality system and its benefits to help others buy-in
- Updating processes and guidelines to identify usage of quality system
- Incorporating user feedback

### **Contact Information**

Margaret Corr

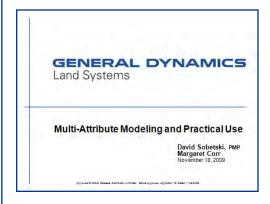
Software Engineering Process Group Lead Section Manager, Software Process, Tools & Environment 38500 Mound Road Sterling Heights, MI 48310 586-825-5787 corrm@gdls.com

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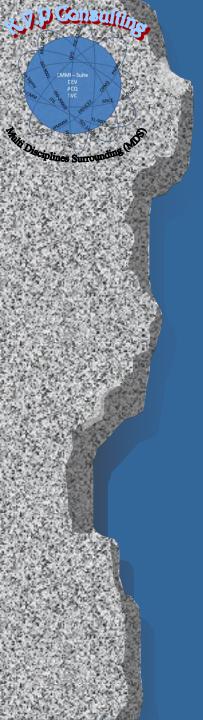
jaskolsk@gdls.com

#### References



 David Sobetski and Margaret Corr, "Multi-Attribute Modeling and Practical Use" General Dynamics Land Systems November 18, 2009 <a href="http://www.dtic.mil/ndia/2009CMMI/9407WednesdayTrack4Sobetski.pdf">http://www.dtic.mil/ndia/2009CMMI/9407WednesdayTrack4Sobetski.pdf</a>

#### GENERAL DYNAMICS

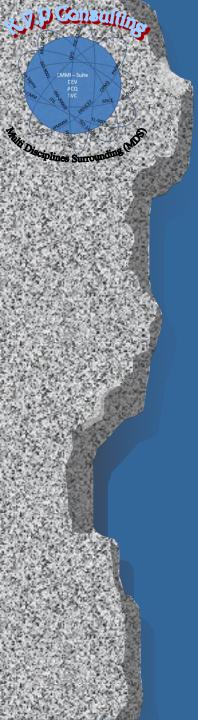


### **Using the SEI Models** and **Practices to Assure System Lifecycle Deliverables Quality and** Compatibility

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K.V.P Consulting

Kobi.Vider@hotmail.com
+972522946676



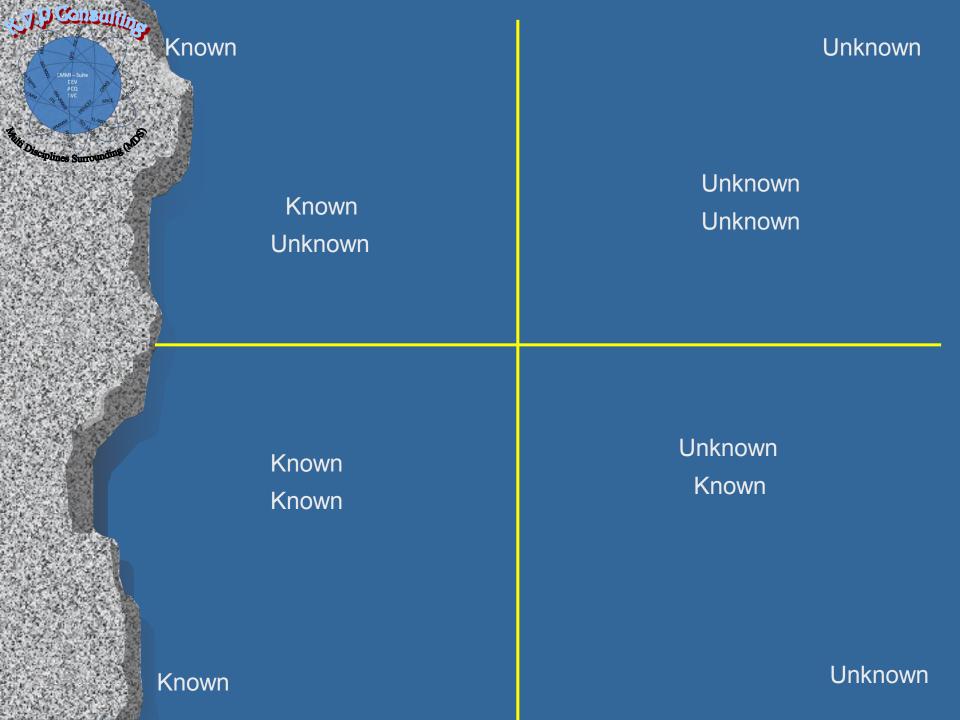


The Theory in the Models is Nice

#### However

Real Life is More Complicated

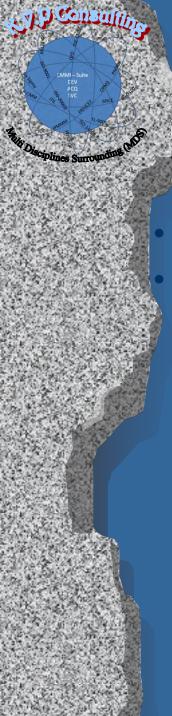
**Much More** 





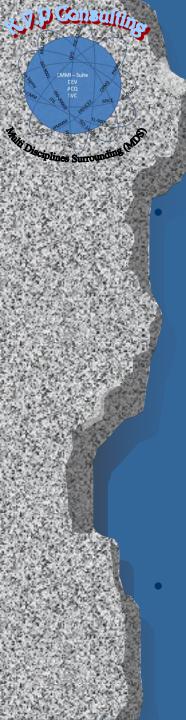
# Considerations for Delivery Management

- The product is successful when the cost of development and manufacturing will drop and your profit will increase
- Produce high-quality (?) products within shorter time lines
- To Correct balance between time and cost versus yield and quality is essential to maximize return on investment



# Considerations for Delivery Management

- Demonstration of the scalability
- Partial selection of what to optimize
  - Material
  - Cost of product
  - Design for
    - Scalability
    - Availability
    - Reliability
    - Serviceability
    - Maintainability
    - Supportability
    - Stability
    - Reusability
  - Sustainability of the Technology as a solution



### Main Roadblocks in Delivery Management

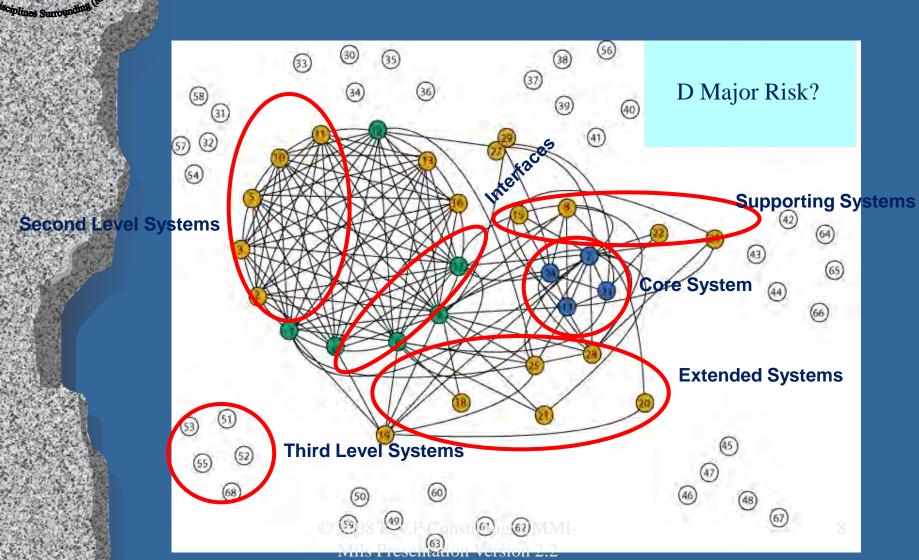
During our analysis and planning, we were able to identify improvement targets in main lifecycle areas such as

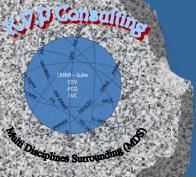
- operations,
- information,
- governance,
- people
- organizational structure,
- portfolios,
- project execution,
- finance.

And as in core process that are critical to the system success such as stakeholder management, technical interfaces and integration.

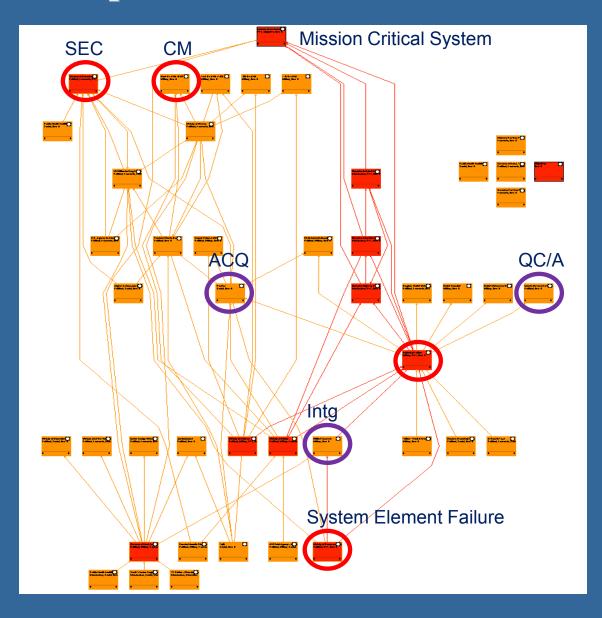
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#### Military Combat Services Support Challenges in the C4ISR Systems



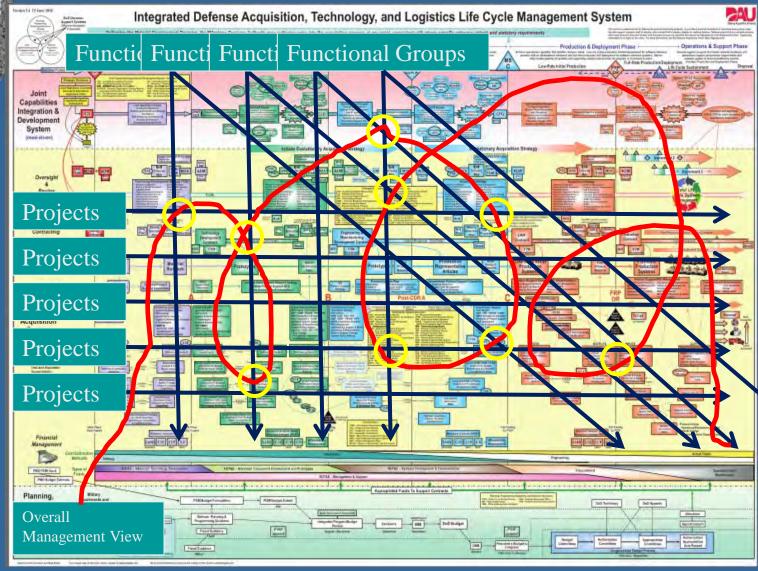


#### **A Complex Effects-based Environment**



### Typical Lifecycle Description

Sciplines Surrounding



# CAMM-Suite BY ACC SUITS COMMENT OF THE PROPERTY OF THE PROPERT

Preparation.

Requirements

Study

Requirements

Analysis

System

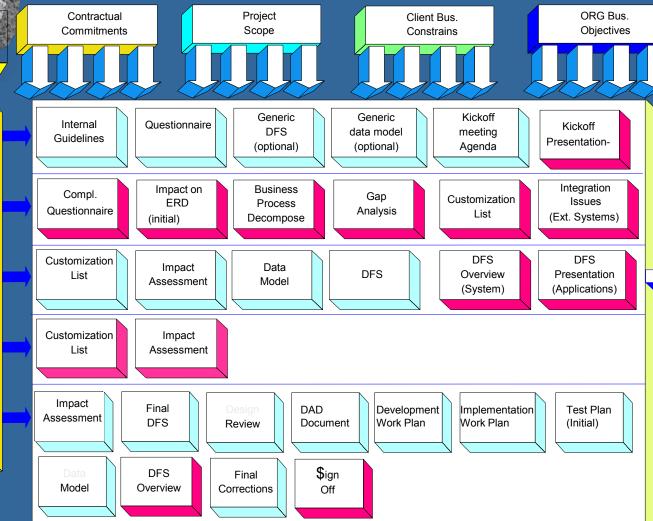
Definition

Finalization

Approval

and

### Simplified View

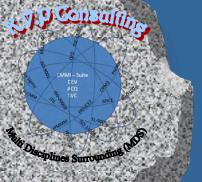


DFS (One per Application)

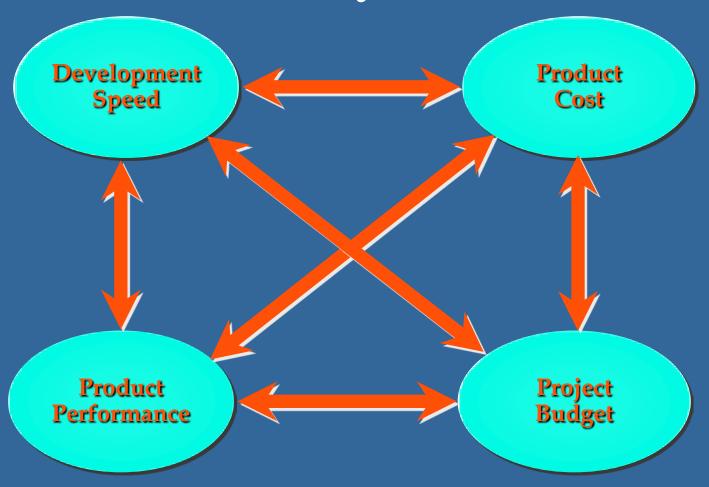
#### Legend

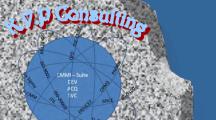
Activity
Carried out in
Dev. Center

Activity Carried out at client site



### The Priority Balance



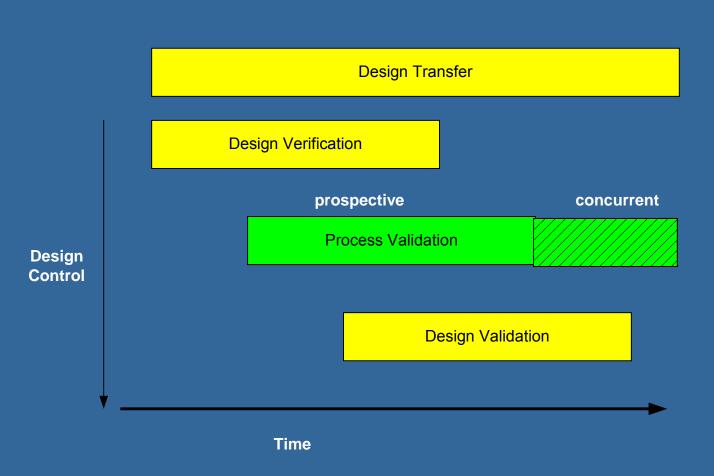


### The Compliance Requirements Challenge

|   |  |                      | DUE  | BTATUB      |               | VI  | VE CRITERIA |               | PRACTICE | RACICE I REPUBLICA |             |          |   |  |
|---|--|----------------------|------|-------------|---------------|-----|-------------|---------------|----------|--------------------|-------------|----------|---|--|
|   | DELMEWBLE  | OWNER                | DATE | Red Green I |               | No. | Med Green   |               |          |                    | Ricci Green |          |   | MOTES                                  |
| _   |  |                      |      | _           | <b>Hallow</b> |     | <u> </u>    | <b>Hallow</b> |          | (1- <del>10)</del> | _           | Wellton. |   |  |
| 1-0   | arryover deliverables from Phase 1   |                      |      |             |               |     |             |               |          |                    | 0           | O        | • |  |
| 1   | Verification that concepts satisfy the Voice of the Customer                     |                      |      | O           | 0             | •   | 0           | 0             | •        |                    |             |          |   | European focus group very positive.    |
| II - Deliverables for Phase 2                       |  |                      |      |             |               |     |             |               |          |                    |             |          |   |  |
| De  | oustrale Features & Performance Requirements to be Superior & M                  | eet Customer Needs   |      |             |               |     |             |               |          |                    | 0           |          | 0 |  |
| 1   | Approval of Final Features and Performance Requirements Document                 | Team                 |      | 0           |               | 0   | 0           |               | 0        |                    |             |          |   | Nomenclature & Accent are TBD.         |
| 2   | Results of customer acceptance & product benchmarking studies                    | Wollern              |      | 0           | 0             |     | 0           | 0             | •        |                    |             |          |   | IO Research complete                   |
| 3   | Feature/cost trade-off decisions   | Team                 |      | 0           | 0             | •   | 0           | 0             | •        |                    |             |          |   | Complete                               |
| Demonstrate that Skeletal Designs are Superior      |  |                      |      |             |               |     |             |               |          |                    | 0           |          | 0 |  |
| 1   | Approvel of Final Subsystem Requirements Document                                | Team                 |      | 0           |               | 0   | 0           |               | 0        |                    |             |          |   | Accent Colors TBD.                     |
| 2   | Integrate hardware/software/sereilized materials & system/subsyste interfaces    | Rauchenplat/Crichton | l    | 0           | O             | •   | 0           | 0             | •        |                    |             |          |   | Completed                              |
| 3   | Skelelal Design Description Document   | Rauschenplat         |      | 0           | 0             |     | 0           | 0             | •        |                    |             |          |   | Completed                              |
| 4   | Critical Paremeter Layouts, with set points & folerances                         | Rauchenplat/Crichton |      | 0           | (0)           |     | 0           |               | 0        |                    |             |          |   | Data for G. D completed.               |
| 5   | Prefiningry bill of materials  | Rauschenplat         |      | 0           | 0             | •   | 0           |               | 0        |                    |             |          |   | Spreadsheet complete. X-status ~ 50%   |
| 8   | Patent position  | Rauschenplat         |      | 0           | 0             | •   | 0           | 0             | •        |                    |             |          |   | No disclosures. No infringements.      |
| Demonstrate that Skeletal System Designs are Robust |  |                      |      |             |               |     |             |               |          |                    | 0           | 0        | • |  |
| 1   | Engineering Evaluation Test Plans  | Webster              |      | 0           | 0             | •   | 0           | 0             | •        |                    |             |          |   | Completed                              |
| 2   | Predictions & evidence of performance and variability                            | Webster              |      | 0           | 0             |     | 0           | 0             | •        |                    |             |          |   | Peri Feitures/Feiture Modes completed. |
| 3   | Conclusions from life & lessping tests, analytical design, & Eng. Eve            | Randendal/Crichton   |      | 0           | 0             | •   | 0           | 0             | •        |                    |             |          |   | EAR. inputs complete, not published.   |
| 4   | Assessment of interactions among parameters & subsystems                         | Rauchenplat/Crichton |      | 0           | 0             |     | 0           | 0             | •        |                    |             |          |   | Completed in Breadboard feeling.       |
| 5   | Peckeging & handling concepts  | Appleton             |      | 0           | 0             |     | 0           | 0             | •        |                    | $\vdash$    |          |   | Same as Cinus                          |
| De  | oustrate Achievable Manufacturing and Operations Plans                           |                      |      | $\top$      |               |     |             |               |          |                    | •           | 0        | 0 | 80 hz green, 50 hz red                 |
| 1   | Selection of critical manufacturing processes, materials & suppliers             | Hoffman              |      | 0           | 0             |     | 0           | 0             | •        |                    |             |          |   | No new processes/suppliers.            |
| 2   | Final production site selection, with implementation plan                        | Strong/Chase         |      |             | (0)           |     | 0           | 0             | •        |                    |             |          |   | Sites Done; 40 kz Done, 50 kz Not      |
| 3   | Tooling & essentity strategy   | Sirong/Chase         |      | 0           | 0             |     | 0           | 0             | •        |                    |             |          |   | Newly same:FPNM tools & processes      |
| 4   | Assessment of risks for manufacturing processes & sources                        | Strong/Chase         |      | 0           | 0             |     | 0           | 0             | 0        |                    |             |          |   | Frame mod process.                     |
| Des   | oustrate Achievable Marketing and Service Plans                                  |                      |      | +           |               |     |             |               |          |                    | 0           | 0        | • | -                                      |
|   | Service plane  | Barrella             |      | 0           | 0             | •   | 0           | 0             | •        |                    |             |          |   | Completed                              |
| 2   | Beseine service approach for diagnostics, tools, parts, preventive maintenance   | Barrella             |      | 0           | O             | •   | 0           | 0             | •        |                    |             |          |   | Completed                              |
| 3   | Updated markeling plan, objectives, positioning & analyses, w/key<br>essumptions | Lee <b>Ali</b> ls    |      | 0           | O             |     | 0           |               | •        |                    |             |          |   | Completed                              |
| 4   | Preliminary sales, distribution, & customer support plans                        | Lee <b>/Mil</b> e    |      | 0           | •             | 0   | 0           | O             |          |                    |             |          |   | © liz complete; SDiz in process        |
| Apr   | roval of and Commitment to Program Management and Business Pt                    | -                    |      |             |               |     |             |               |          |                    | •           |          | 0 | 80 kz yellow, 50 kz red                |
| 1   | Approval of & commitment to Program Business Plan                                | Werfin               |      | 0           | (0)           | •   | 0           | 0             | •        |                    |             |          |   | Completed                              |
| 2   | Financial case requirements  | Werfin               |      | •           | O             | •   | 0           |               | •        |                    |             |          |   | 60 hz complete; 50hz in process        |
|   |  |                      |      |             |               |     |             |               |          |                    |             |          |   |  |

#### Design Controls & Process Validation

iplines Surrounding C





Organizations that need to manage matrix / complex business unit with functional teams or systems and to establish business relationships with other businesses face major challenges including:

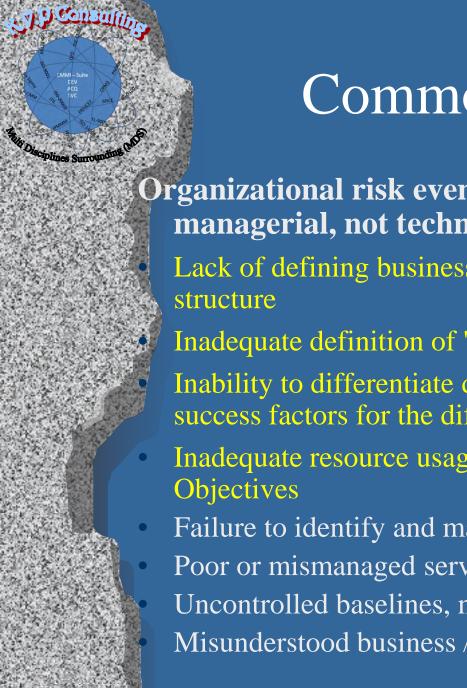
The need for creating a win-win-situation

The effort to align business processes and link up information systems across company borders

Organizations do not know how to efficiently use interoperability from the business perspective to identify the fundamental artifacts that are related to the business interoperability







#### Common Failures - 1

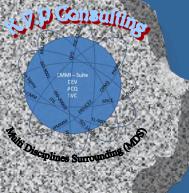
Organizational risk events are predominantly managerial, not technical.

Lack of defining business objectives in quantitative terms and

Inadequate definition of 'Good Enough' level

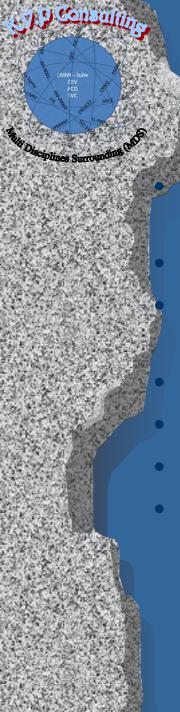
Inability to differentiate different business objectives and success factors for the different domains and lifecycle phases

- Inadequate resource usage and adjustment to Plan and
- Failure to identify and manage risks
- Poor or mismanaged service / operational requirements
  - Uncontrolled baselines, no configuration management
  - Misunderstood business / operational needs and objectives



#### Common Failures - 2

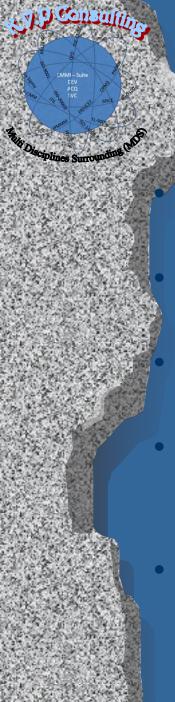
- Poor contractor acquisition or management
- Lack of skills, capability and training
- Poor planning and tracking
  - Value Stream
  - Equipment
  - Resources
  - Finance
- Poor / misuse of data and measurements
- Inability to estimate accurately
- No quality assurance / control
- Poor communications



### The Operational Need

Management capability level from both professional and knowledge level

- Performance and reporting norms
- Self management and self discipline maintaining personal professional and knowledge capabilities
- Individual and team discipline
- Cooperation and knowledge and resource sharing
- Appropriate visibility of information, data and capabilities
- Quality of readiness and preparedness for performing mission



### The Operational Need

Centralized resource management and appropriate utilization and usage of it

Multidimensional management (future planning, unit strategy, short term objectives, the immediate objectives)

Initiating, developing and implementation management of new processes and technologies

Balanced planning and deploying new processes and tools improvements and new technologies in a measured way that will quantify the improvement vs. expectations

Information, data and communication security



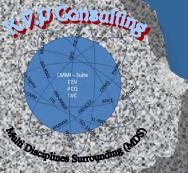
#### The Operational Need

Each person working in the implementation organization will need to do the following:

- Access the processes descriptions
- Understand the lifecycle at a top level
- Understand in detail of the processes that he or she performs

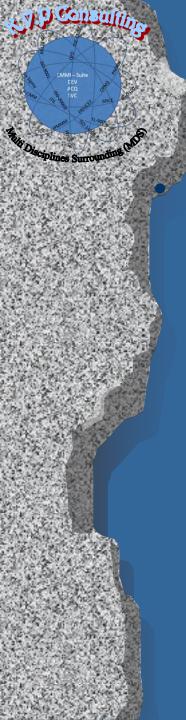
#### In addition, managers must do the following:

- Understand the lifecycle at a top level
- Understand the leadership change management expectations in detail
- Understand how to lead the unit using the new processes
- Access historical measurement data for all processes and product versions performance
- Support implementation of new processes in their own surroundings
- Remove roadblocks to implementation



## Main Risks Areas and Impact (Example Only)

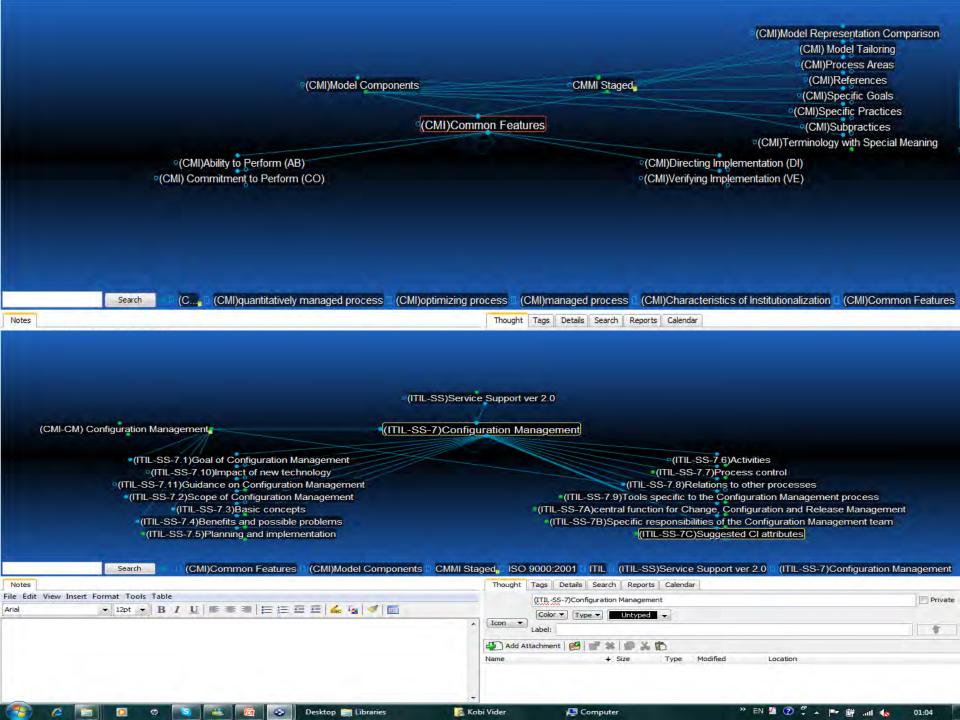
| Risk Class      | Risk<br>Type   | Activity or Event      | Examples  | Mitigation   | Frequency<br>& Severity |
|-----------------|--|------------------------|---|--|-------------------------|
| People          | Internal Unauthorized<br>Activity<br>Lack of skille<br>personnel |                        | Rogue Trading High employee turnover                                  | Partially insured  |                         |
| People          | External   | Fraud                  | Theft   | Partially insured  |                         |
| Systems         | Internal   | Model Risk             | Model/Methodology<br>error<br>Mark-to-model error                     | Technical risk<br>audit<br>Improve quality of<br>models/people |                         |
| Systems         | External   | Technology Risk        | Telecommunication failure Blackouts                                   | Contingency<br>planning<br>Insurance                           |                         |
| Processes       | Internal   | Transaction Risk       | Execution error<br>Settlement error<br>Documentation/contract<br>risk | Improve<br>processes   |                         |
| Asset<br>damage | Internal   | Physical asset risk    | Pipeline Rupture Production loss Unexpected plant outage              | Partially insured<br>Contingency<br>planning                   |                         |
| Asset<br>damage | External   | Physical asset<br>risk | Uninsured or<br>irrecoverable loss or<br>damage to assets             | Insurance  |                         |

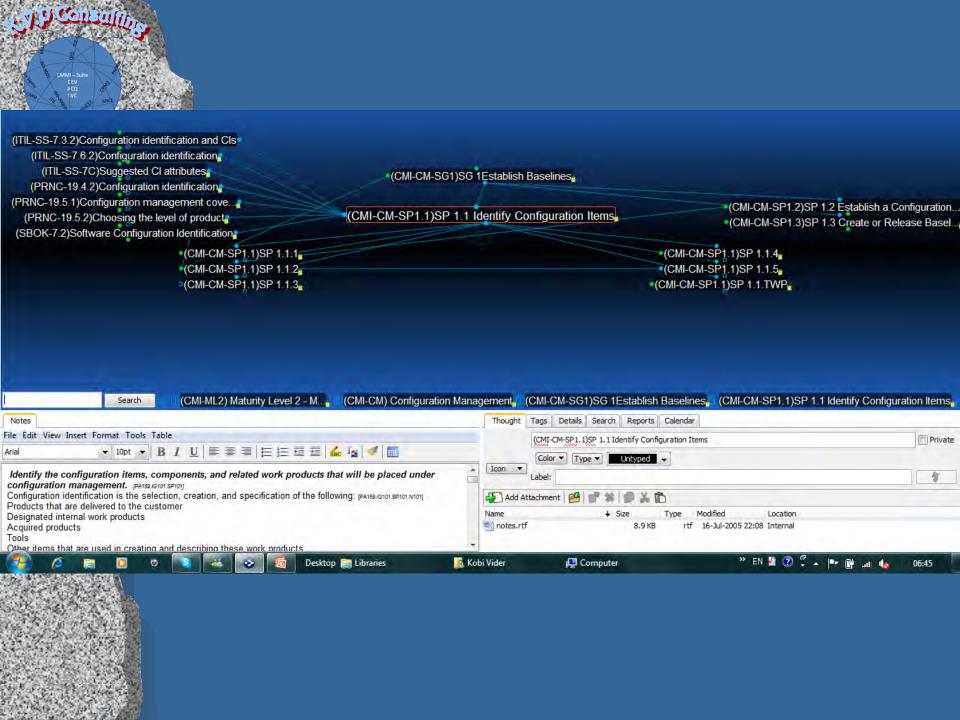


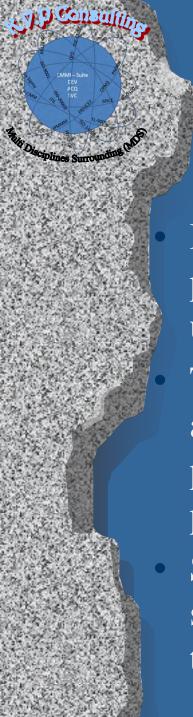
### The Challenge

This situation where the organization is running

- separate process improvements on different parts of the system / product lifecycle
- With partial overall view in interactions and handshakes between these groups is introducing inefficient usage of
  - resources,
  - expensive maintenance of duplicate infrastructures
  - and Organizational Sets of Standards Processes as well as assets,
- May result in less quality and impacting the competitive edge with their global counterparts.

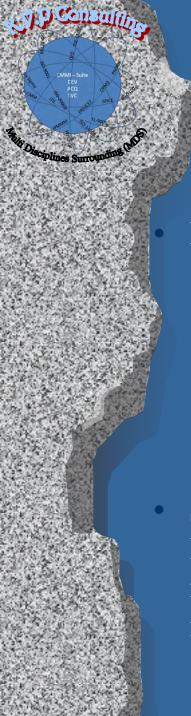






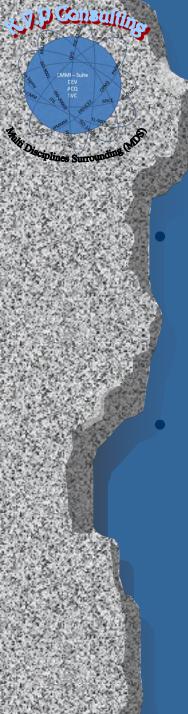
# The Approach to the Solution Concept

- Best practices in the model focus on activities for providing quality services to the customer and end users
- To identify improvement targets in main lifecycle areas such as operations, information, governance, people and organizational structure, portfolios, project execution, and finance
- Select processes that are critical to the system success such as stakeholder management, technical interfaces and integration



## The Approach to the Solution Concept

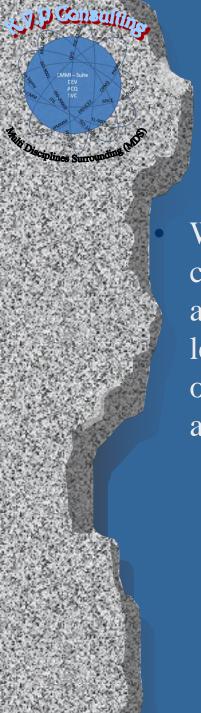
- Build an action plan composed from the following main steps
  - Organizational map
  - Functional team and groups size and role in the lifecycle
  - Full lifecycle map
  - Setting improvement targets
  - Gap analysis
- Suggesting to the senior management to address the lifecycle and process (as a whole) as a complex of crossing interfaces and to add additional content to the lifecycle map (as a layer)



### The Conceptual Solution

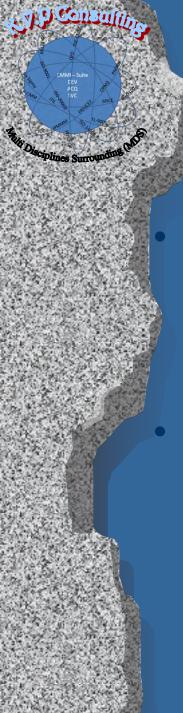
Building on contingency theory, it outlines a comprehensive framework suggesting a fit between the level of Mission interoperability and environmental as well as internal contingencies.

Moving from the current environment of basic process and way of thinking toward a more controlled and measured process to reduce the overwhelming amount of information that build decisions



### The Conceptual Solution

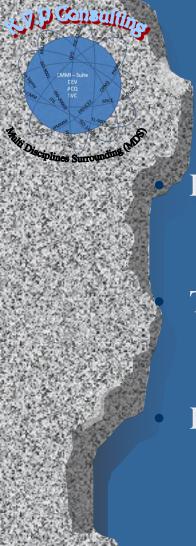
We have found that Maturity Models and practices combined with some other industry standards and methods as a new integrated approach can be used as tools to leverage procedures to support the lifecycles and the organizational business objectives and capability, readiness and preparedness to achieve improvement and excellence.



### The Conceptual Solution - 1

Building on contingency theory, it outlines a comprehensive framework suggesting a fit between the level of business interoperability and environmental as well as internal contingencies.

Moving from the current environment of basic processes and way of thinking toward a more controlled and measured set of processes to reduce the overwhelming amount of information that is now required to build decisions



## The Four Main Entities and Their Role

#### Facility

• Provide the 'hard and physical' working environments and infrastructure

#### Technology

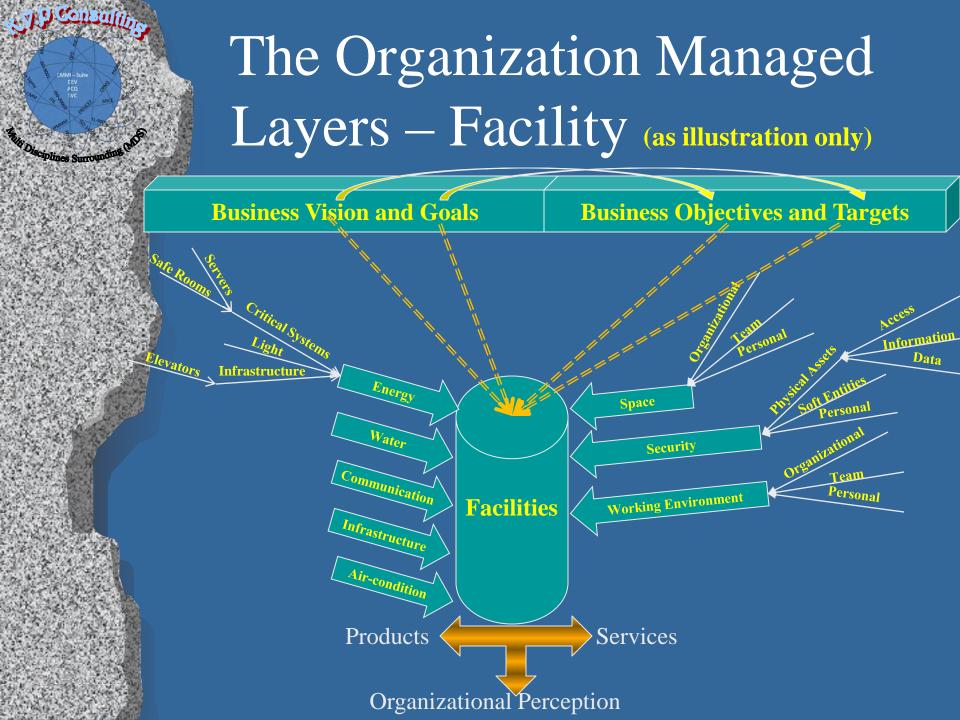
• Provide the 'soft and intangible' working environments and infrastructure and tools

#### Process

• Provide the working procedures and instructions, which assume to guide in the most effective way how to use the facilities and technology to achieve the business objectives by the people

#### People

• Provide the individuals that build the teams within the organizational units and groups, that perform the tasks and activities described in the process

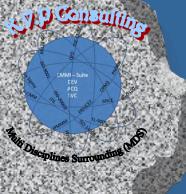


# The Organization Managed Layers — Technology (as illustration only)

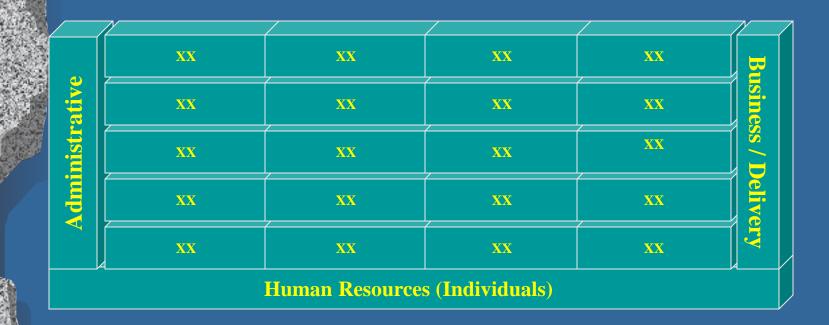
|                       | Safety Equipment         | Security Equipment       | Dashboards                  | Support Application             |  |  |  |
|-----------------------|--------------------------|--------------------------|-----------------------------|---------------------------------|--|--|--|
|                       | Maintenance Equipment    | Manufacturing Equipment  | Maintenance Environments    | Manufacturing Environments      |  |  |  |
|                       | <b>Development Tools</b> | Administrative Equipment | Administrative Applications | <b>Development Environments</b> |  |  |  |
|                       | Desktop / Laptop         | Access System            | Knowledge                   | Information                     |  |  |  |
| New York              | Servers                  | Phones                   | Intellectual Property       | Patents                         |  |  |  |
| 'Physical' Technology |                          |                          | 'Soft' Technology           |                                 |  |  |  |

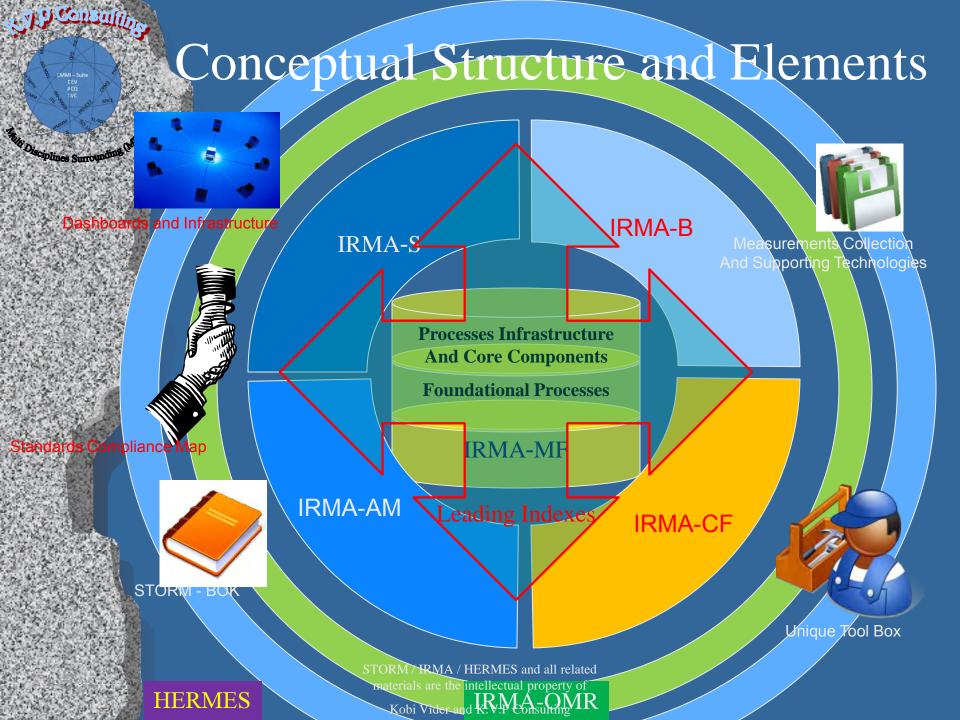
# The Organization Managed Layers – Processes (as illustration only)

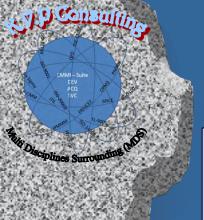
|                                   | XX                | XX            | A                                    | Acquisition / Procurement | Support                |  |  |  |
|-----------------------------------|-------------------|---------------|--------------------------------------|---------------------------|------------------------|--|--|--|
|                                   | Work Environments | Safety        |                                      | Maintenance               | Manufacturing          |  |  |  |
|                                   | Ethics            | Environmental |                                      | Development               | Managerial (Portfolio) |  |  |  |
|                                   | Human Resources   | Security      |                                      | Knowledge                 | Managerial (Program)   |  |  |  |
|                                   | Legal             | Finances      |                                      | Intellectual Property     | Managerial (Project)   |  |  |  |
| Administrative (Corporate 'wise') |                   |               | Business / Delivery (Product 'wise') |                           |                        |  |  |  |



# The Organization Managed Layers – People (as illustration only)







# Solution Architecture

### **Preface**

Part One - About the Model

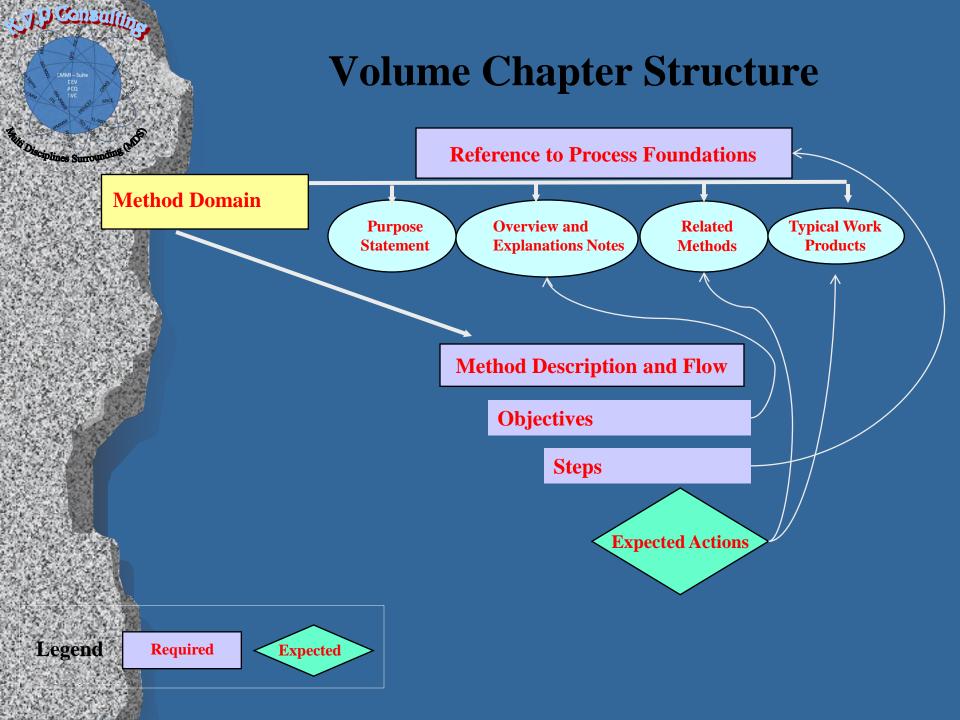
- 1. Introduction
- 2. Model Components
- 3. Working with the Model
- 4. Relationships Among Areas
- **5. Implementation Guidelines**
- 6. Interpretation Guidelines

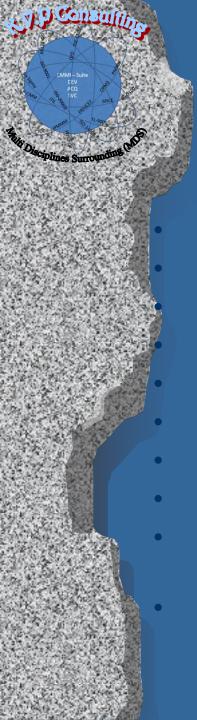
### Part Two - Model Body

- 1. Volume #1 Process Foundations
- 2. Volume #2 Foundation Processes
- 3. Volume #3 Delivery Processes
- 4. Volume #4 Support Processes
- 5. Volume #5 Skills Building Processes
- 6. Volume #6– Process Improvement and Optimization Capabilities

Part Three – The Appendices and Glossary References Acronyms

Glossary





# Operational Processes KPI's

Known Capability and Stable

**Defined Ingredients** 

**Known Critical Elements** 

Meeting Objectives

Controlled Interfaces

Responsive / Modifiable

Resilience / "Agile"

Relevant 'What If's Scenarios

Accepted Tolerance /

Freedom Boundaries

Predictable Outcomes

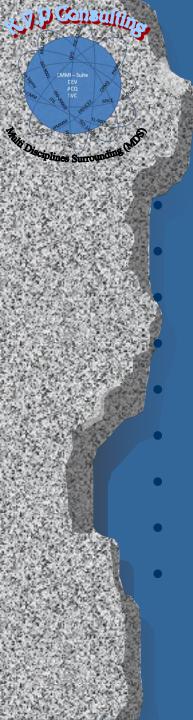
Influence of Critical Elements on process output

Process resources utilization

'What If's Scenarios

Process elements capability

Quantitative definition of process ingredients



# System Compliances' KPI's

Scalability

Availability

Reliability

Serviceability

Maintainability

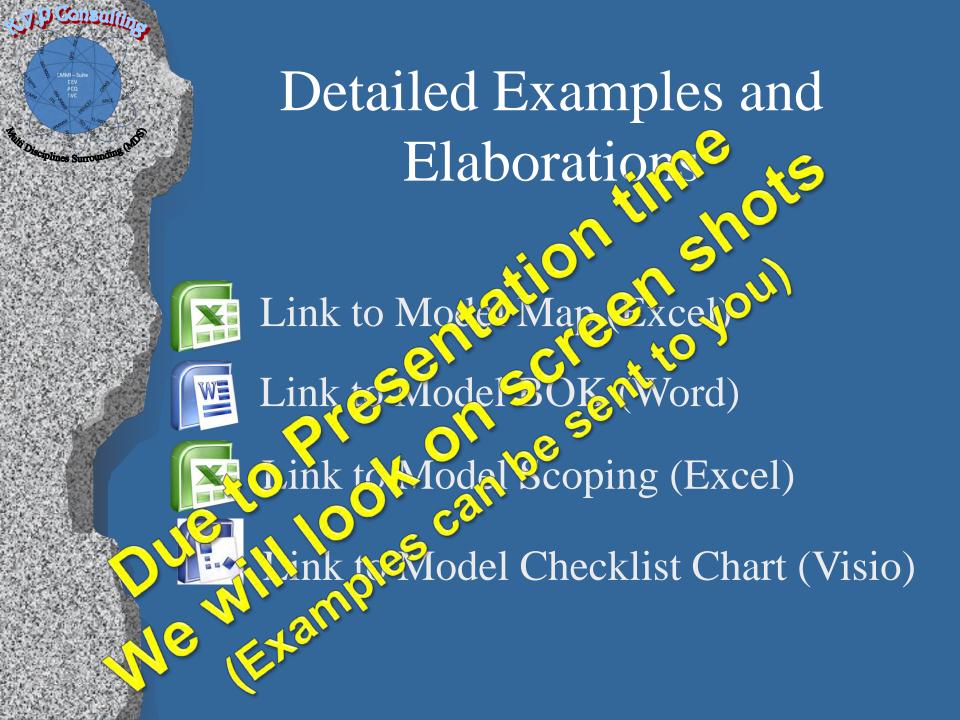
Supportability

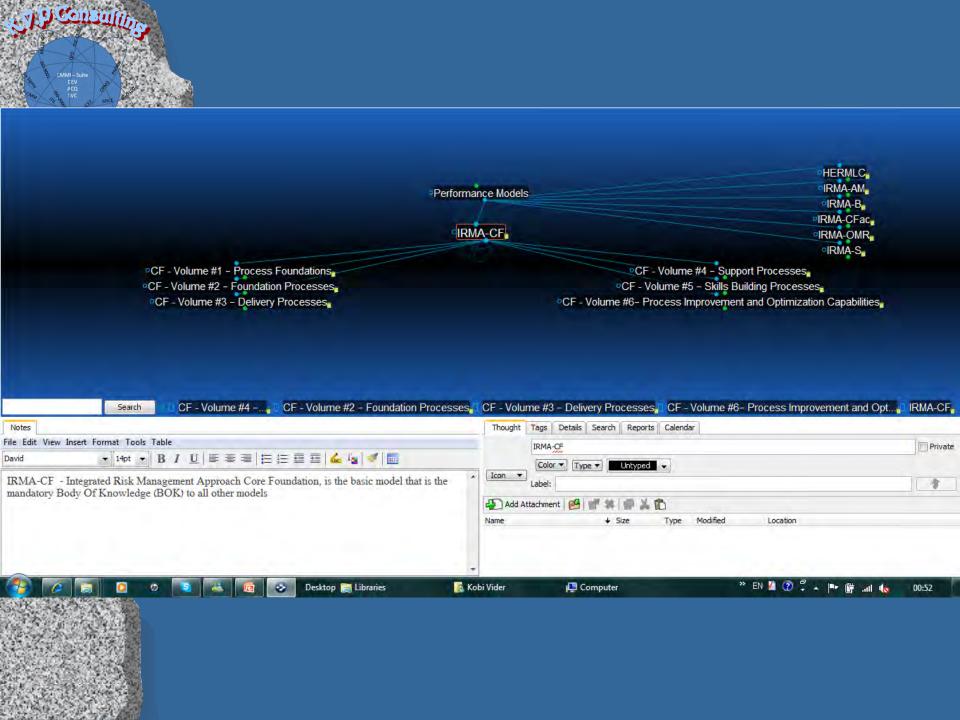
Stability

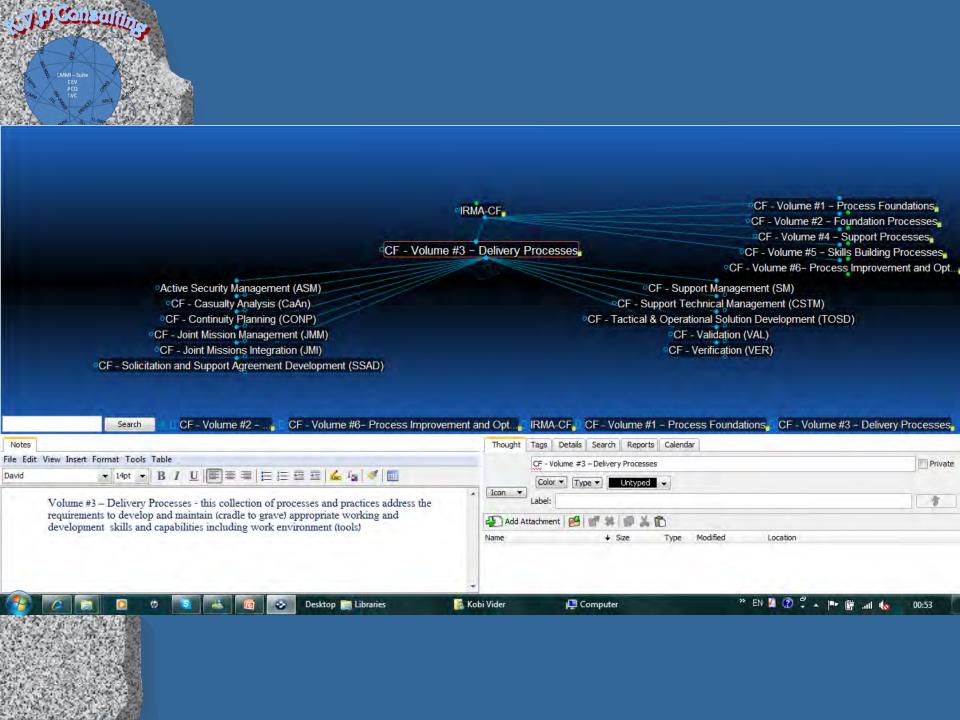
Reusability

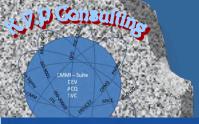
Soundness of Technology Future

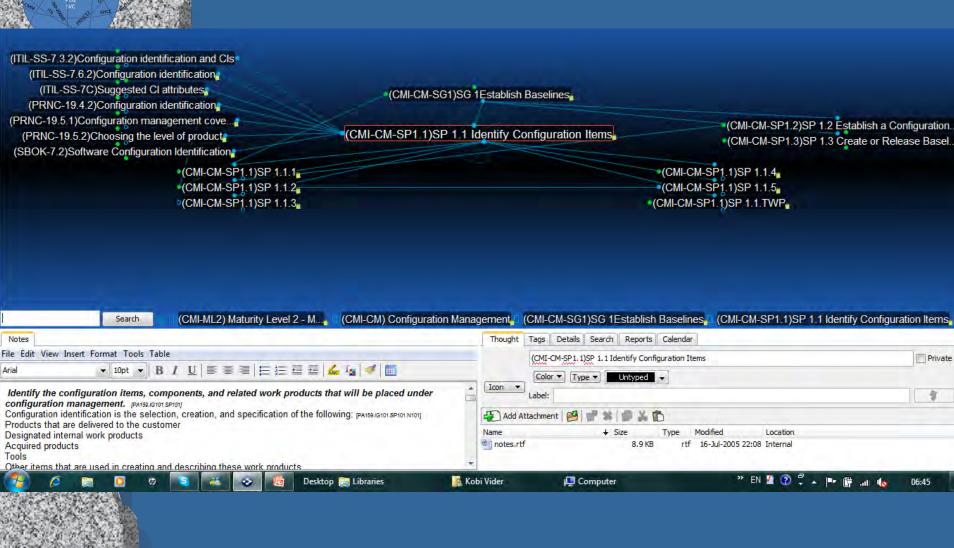
- Technology flexibility
- Capacity growth models
- System (size) growth models
- Time to Restore
- Down time
- MTBF
- Support calls causes and density
- Technology extendibility



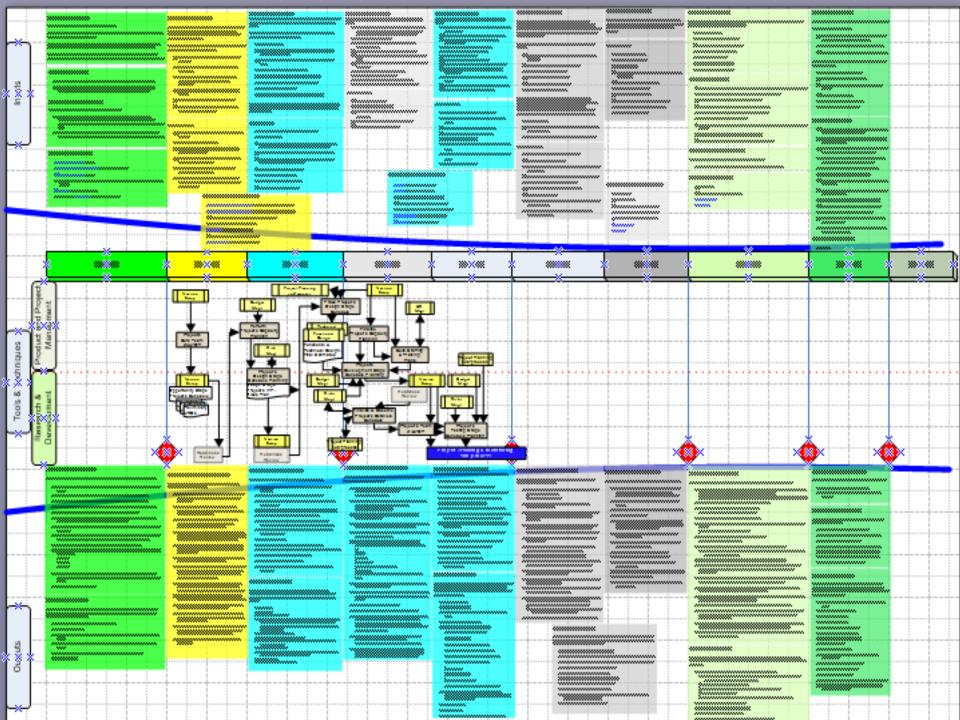


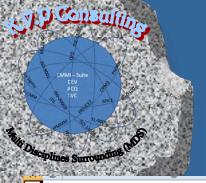






| Company  | 20          |  |              |      |    |                  |     | Carrell |     |          |               |     |             |     |     |             | tru fasalissal | G             | 1        |   |
|--|-------------|--|--------------|------|----|------------------|-----|---------|-----|----------|---------------|-----|-------------|-----|-----|-------------|----------------|---------------|----------|---|
| March   Second Annual Content   Second Annual Conten   |             |  |              |      |    |                  |     |         |     | Saulce   | Analonia      |     | Infrantract | arr |     | l '         |                |               | I        |   |
| Configuration   Configuratio   | •           | ell Hamr   | 98           | IS   | TW | PH IDeligeral HD | рно |         | PS  | PA       |               |     |             |     | IT  | 98 IPconced | HAR IN HHI     | Pragras Grass | <u> </u> |   |
| Continue Processes Francisco    |             |  | 2            | 2    |    |                  |     | 1       | 1   | 1        | 1             |     |             |     |     |             | 3              |               | 12       | 1 |
| Comparison State State State   Comparison   Comparison State Sta   |             |  | -            | _    |    |                  |     |         |     |          |               |     |             | •   |     |             | _              |               |          | 1 |
| Internal Project Programs  |             |  | 2            | 2    |    | 1                | 1   | 2       |     |          |               |     |             |     |     |             |                |               | 18       | 1 |
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| GP 2.5 Train Prople GP 2.5 Train Prople GP 2.6 Hamilton Active Relevant State between GP 2.7 Hamilton and Control the Process GP 2.7 Hamilton and Control the Process GP 2.8 Hamilton Addresses GP 2.8 Hamilton Addresses GP 2.8 Hamilton With Higher Level Hamagement  GP 2.4 Evaluation to Defined Process GP 3.2 College Improvement Information  GP 3.2 College Improvement Information  GP 4.2 Evaluation Control the Process GP 5.2 Control Read Control Process Improvement  GP 5.2 Control Read Control Process Improvement  GP 5.2 Control Read Control Process Improvement  GP 5.3 Control Read Control Process Improvement  GP 5.4 Evaluation Control The Process  GP 5.5 Control Read Control Process Improvement  GP 5.6 Control Read Control Process Improvement  GP 5.7 Control Read Control Process Improvement  GP 5.8 Control Read Control Process Improvement  GP 5.9 Control Read Control Process Improvement  GP 5.1 Evaluation Process Improvement  GP 5.1 Evaluation Process Improvement  GP 5.1 Evaluation Process Improvement  GP 5.2 Control Read Control Process Improvement  GP 5.3 Evaluation Process Improvement  GP 5.4 Evaluation Process Improvement  GP 5.5 Control Read Control Process Improvement  GP 5.7 Evaluation Process Improvement  GP 5.8 Evaluation Process Improvement  GP 5.9 Evaluation Process Improvement  GP 5.1 Evaluation Process Improvement  GP 5.2 Control Read Control Process Improvement  GP 5.3 Evaluation Process Improvement  GP 5.4 Evaluation Process Improvement  GP 5.5 Evaluation Process Improvement  GP 5.6 Evaluation Process Improvement  GP 5.7 Evaluation Process Improvement  GP 5.8 Evaluation Process Improvement  GP 5.9 Evaluation Process Improvement  GP 5.9 Evaluation | 1000        |  |              |      |    |                  |     |         |     |          |               |     |             |     |     |             |                |               |          |   |
| GP 2.5 Hanage Configurations GP 2.7 Identify and Insular Referent Stateholders GP 2.8 Uniform and Control the Process GP 2.9 Objectively Evaluate Addresses GP 2.10 Review Statem with Higher Learn Hanagement  GP 2.1 Evaluation and Control Process GP 3.2 Collect Improvement Information  GP 3.2 Collect Improvement Information  GP 4.2 Statistic Outpitalism Objections for the Process GP 4.2 Statistic Outpitalism Objections for the Process GP 4.2 Statistic Subprocess Professions  GP 5.2 Correct Read Control Process  GP 5.2 Correct Read Control Process  1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1   |             |  | l .          |      |    |                  |     |         |     |          |               |     |             |     |     |             |                |               |          |   |
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| GP 2.1 Hazilar and Caulcul like Penareus GP 2.3 Okjesliand Endade Althereuse GP 2.11 Region States with Higher Level Hazagement  GP 3.1 Endadish Defined Penareus  GP 3.1 Endadish Defined Penareus  GP 3.2 Called Improvement Information  GP 4.1 Endadish Gazatilation Okjesliana for the Penareus  GP 4.2 Statition Subprovement Penfareuses  GP 5.2 Carrent Real Casses of Penkless  1  GP 5.2 Carrent Real Casses of Penkless  1  |             |  |              |      |    |                  |     |         |     |          |               |     |             |     |     |             |                |               |          |   |
| GP 2.1 Objectively Enabate Adherence GP 2.18 Resirus States with Higher Level Hasagement  GP 3.1 Entablish a Defined Present GP 3.2 Cellevil Improvement Information  GP 3.2 Cellevil Improvement Information  GP 4.1 Entablish Objective Subgraves Performance  GP 4.2 Stabilities Subgraves Performance  GP 5.1 Ensure Continuous Presents Improvement  GP 5.2 Correal Resil Consent President  1  1  1  1  1  1  1  1  1  1  1  1  1  | E 500       |  |              |      |    |                  |     |         |     |          |               |     |             |     |     |             |                |               |          |   |
| GP 2.1 Entablish a Defiard Penares  GP 3.1 Entablish a Defiard Penares  GP 3.2 Called Improvement Information  3  GP 4.2 Entablish Quantitation Objections for the Penares  GP 4.2 Stability Subgresses Performance  3  GP 5.2 Carred Real Casers of Peabless  3  GP 5.3 Carred Real Casers of Peabless  3  3  4  5  6  7  7  7  7  7  7  7  7  7  7  7  7   | (C) (P)     |  |              |      |    |                  |     |         |     |          |               |     |             |     |     |             |                |               |          |   |
| GP 9.1 Entablish a Defined Penerus  GP 9.2 Cultrel Improvement Information  GP 4.2 Entablish Quantitation Objections for the Penerus  GP 4.2 Stabilities Subgression Performance  GP 9.3 Entable Control Ruel Control Penerus  GP 9.4 Control Ruel Control Penerus  1  1  1  1  1  1  1  1  1  1  1  1  1  |             |  |              |      |    |                  |     |         |     |          |               |     |             |     |     |             |                |               |          |   |
| GP 9.2 Cultral Improvement Information  GP 9.4 Entablish Quantifation Objections for the Penness  GP 9.5 Enter Cultiman Penness Improvement  GP 9.5 Current Runt Course of Penhlem  1  1  1  1  1  1  1  1  1  1  1  1  1  | 18          | F C. 10 KPOIPE SISSES WITH HIGHPY CPOPT TISSAFORES   | ·            |      |    | <del></del>      |     |         |     |          |               | _   |             |     |     |             |                |               |          |   |
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| GP 5.2 Curreal Rual Casara of Problems  1  1  1  1  1  1  1  1  1  1  1  1  1  | <b>3</b> 0  | P. 4.1 Entablish Quantitation Objections for the Passace   |              |      |    |                  |     |         |     |          |               | _   |             |     |     |             |                |               |          |   |
| GP 5.1 Ensure Continuous Penerual approximated GP 5.2 Current Read Conserve of Problems  3 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1   |             |  | ٠,           |      |    |                  |     |         |     |          |               |     |             |     |     |             |                |               |          |   |
| GP 5.2 Carreal Rual Causes of Peakless  3  | 13          |  |              |      |    |                  |     |         |     |          |               |     |             |     |     |             |                |               |          |   |
| GP 5.2 Carreal Rual Causes of Peakless  3  | 32          | P 5.1 E Carlianna Pray !   |              |      |    |                  |     |         |     |          |               |     |             |     |     |             |                |               |          |   |
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# Risk Evaluation Checklist

### Business Continuity Plan (BCP) Complete Audit Checklist

| No       | Procedures  | Status | Notes |
|----------|---|--------|-------|
| 1        | Determine examination scope and objectives for  |        |       |
|          | reviewing the Business Continuity Plan (BCP)  |        |       |
|          | program.  |        |       |
| 2        | Determine the existence of an appropriate   |        |       |
|          | enterprisewide Business Continuity Plan (BCP).  |        |       |
| 3        | Determine the quality of Business Continuity Plan   |        |       |
|          | (BCP) oversight and support provided by the board   |        |       |
|          | of directors and senior management.   |        |       |
| 4        | Determine whether an adequate Business Impact   |        |       |
| 1        | Analysis (BIA) and risk assessment have been  |        |       |
|          | completed.  |        |       |
| 5        | Determine whether appropriate risk management   |        |       |
| 1        | over the Business Continuity Plan (BCP) process is  |        |       |
|          | in place.   |        |       |
| 6        | Determine whether the Business Continuity Plan  |        |       |
| 1        | (BCP) include appropriate testing to ensure the   |        |       |
| 1        | business process will be maintained, resumed,   |        |       |
| <u> </u> | and/or recovered as intended.   |        |       |
| 7        | Determine whether the IT environment has a properly   |        |       |
| 1        | documented Business Continuity plan that  |        |       |
| 1        | complements the enterprise-wide and other   |        |       |
| <u> </u> | departmental Business Continuity plans.   |        |       |
| 8        | Determine whether the Business Continuity Plan  |        |       |
|          | (BCP) include appropriate hardware backup and   |        |       |
| <u> </u> | recovery.   |        |       |
| ª        | Determine whether the Business Continuity process   |        |       |
| 1        | includes appropriate data and application software  |        |       |
| 10       | backup and recovery.  |        |       |
| 1 "      | Determine whether the Business Continuity Plan  |        |       |
| 1        | (BCP) include appropriate preparation to ensure the data center recovery processes will work as |        |       |
|          | intended.   |        |       |
|          | Determine whether the Business Continuity Plan  |        |       |
| "        | (BCP) include appropriate security procedures.  |        |       |
| 12       | Determine whether the Business Continuity Plan  |        |       |
| "        | (BCP) address critical outsourced activities.   |        |       |
| 12       | Discuss corrective action and communicate   |        |       |
| 1 13     | Discuss corrective action and communicate   | I      | l     |

### **Data Recovery Templates and Checklist**

Conducting a recovery test

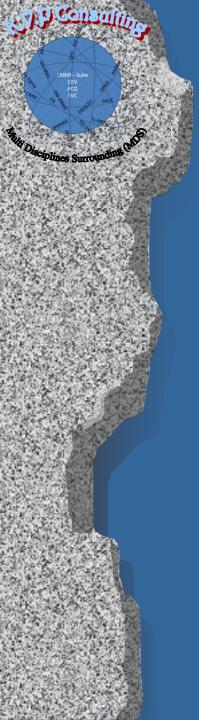
|    |   |   | Status |     | Notes |
|----|---|---|--------|-----|-------|
| N  | Activity  | Υ | N      | N/A |       |
| 1  | Select the purpose of the test. What aspects of the plan are being evaluated?                                   |   |        |     |       |
| 2  | Describe the objectives of the test. How will you measure successful achievement of the objectives?             |   |        |     |       |
| 3  | Meet with management and explain the test and objectives. Gain their<br>agreement and support.                  |   |        |     |       |
| _  | Have management announce the test and the expected completion time.   |   |        |     |       |
| _  | Collect test results at the end of the test period.  Evaluate results. Was recovery successful? Why or why not? |   |        |     |       |
|    | Determine the implications of the test results. Does successful recovery  |   |        |     |       |
| 7  | in a simple case imply successful recovery for all critical jobs in the tolerable outage period?                |   |        |     |       |
| _  | Make recommendations for changes. Call for responses by a given   |   |        |     |       |
| _  | Notify other areas of results. Include users and auditors.  |   |        |     |       |
| 10 | Change the disaster recovery plan manual as necessary.  |   |        |     |       |

#### Areas to be tested

|    |     |   |   | Status |     | Notes |
|----|-----|---|---|--------|-----|-------|
|    | N   | Activity  |   |        |     |       |
| П  | 0   |   | Y | N      | N/A |       |
| П  |     | Recovery of individual application systems by using files and           |   |        |     |       |
| Ш  | _1  | documentation stored off-site.  |   |        |     |       |
| П  |     | Reloading of system tapes and performing an IPL by using files and      |   |        |     |       |
| LJ | 2   | documentation stored off-site.  |   |        |     |       |
| Γ  | 3   | Ability to process on a different computer.                             |   |        |     |       |
| П  |     | Ability of management to determine priority of systems with limited     |   |        |     |       |
| П  | 4   | processing.   |   |        |     |       |
| П  | - 5 | Ability to recover and process successfully without key people.         |   |        |     |       |
|    |     | Ability of the plan to clarify areas of responsibility and the chain of |   |        |     |       |
|    | 6   | command.  |   |        |     |       |







# BCP TOC

### **Business Continuity Planning Components**

### **Getting Started**

### Section 1

- 1. Assign departmental business continuity responsibilities.
- 2. Department mission and business functions/processes.
- Identification and evaluation of scenarios, risks, events and threats.

### Developing the Plan

### Section 2

- Document recovery plans to recover critical functions for each scenario.
- 5. Determine details to complete tasks.
- 6. List contact information.
- 7. List necessary resources and reference materials.

### Maintaining the Plan

Section 3

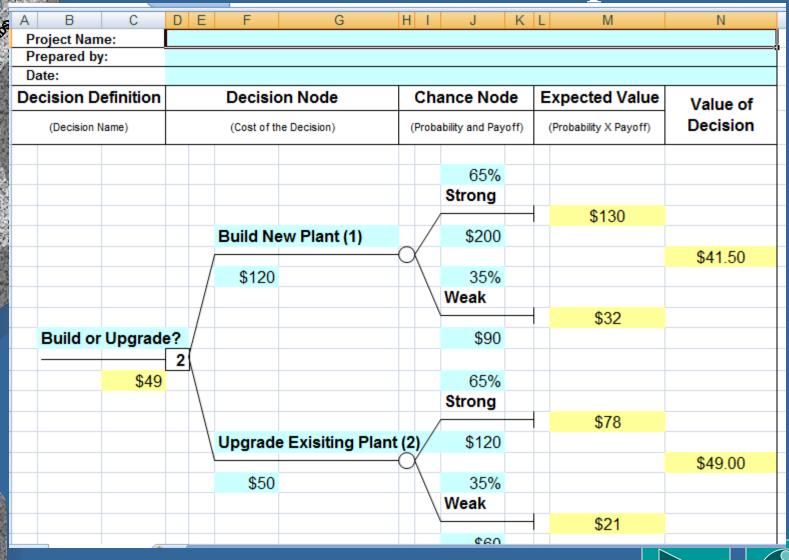
- 8. Train personnel on the plan.
- 9. Test (validate) the plan.
- 10. Maintain the plan.

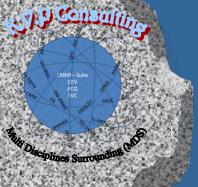




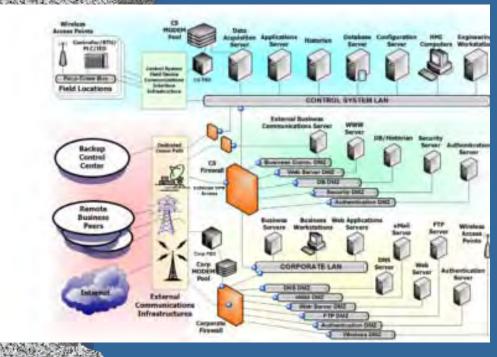
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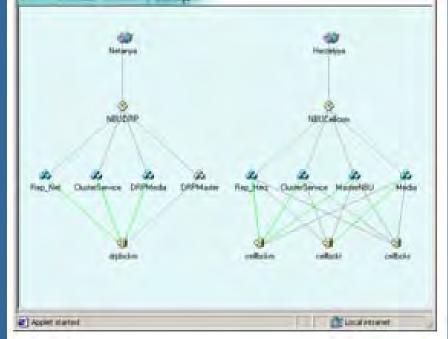
# Decision Tree Template



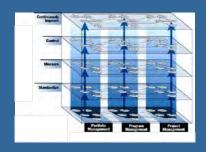


# Infrastructures and Application Mapping





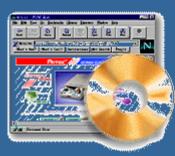




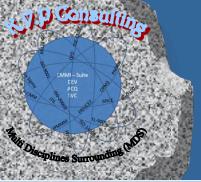
Scoping



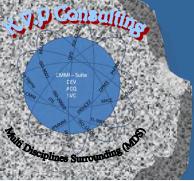
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Slides

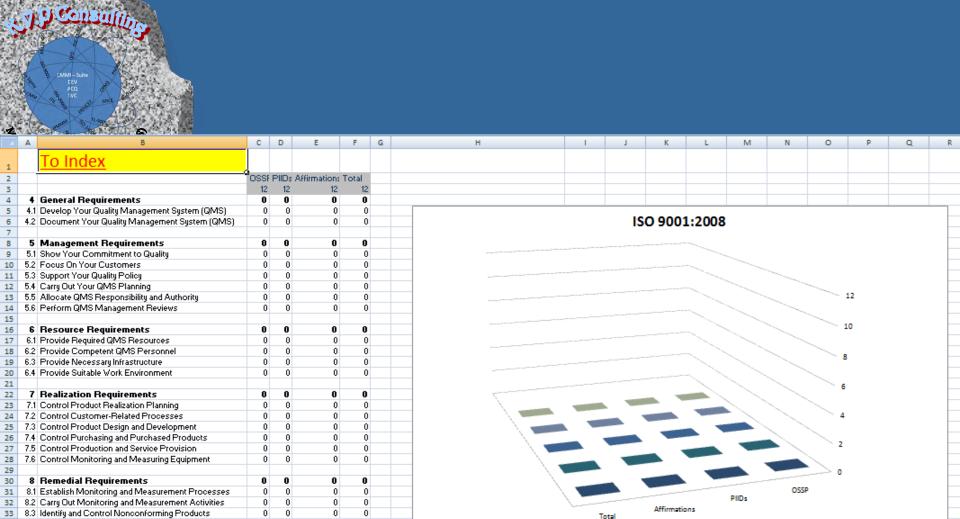


| 8                                  |  | D                          | E       | F              | G         | н           | 1            | i             | K            | L     | M        | N    | 0       | P    | Q   | R   |   |
|------------------------------------|--|----------------------------|---------|----------------|-----------|-------------|--------------|---------------|--------------|-------|----------|------|---------|------|-----|-----|---|
|                                    |  |                            |         |                |           |             |              |               |              |       |          |      |         |      |     |     |   |
|                                    |  |                            |         |                |           |             | 10.000       |               |              |       |          |      |         |      |     |     |   |
|                                    |  |                            |         |                |           |             | ments for th |               |              |       |          |      |         |      |     |     |   |
| Strategy, Managemen                | t, and Regulatory  |                            |         |                | Blue text | = Descripti | ve characte  | ristics or de | sired traits |       |          |      |         |      |     |     |   |
| Vision, planning,                  |  |                            |         |                |           |             |              |               |              |       |          |      |         |      |     |     |   |
| decision making,                   |  |                            |         |                |           |             |              |               |              |       |          |      |         |      |     |     |   |
| strategy<br>execution, discipline, |  |                            |         |                |           |             |              |               |              |       |          |      |         |      |     |     |   |
| regulatory, and                    |  |                            |         |                |           |             |              |               |              |       |          |      |         |      |     |     |   |
| investment                         |  |                            |         |                |           |             |              |               |              |       |          |      |         |      |     |     |   |
| investment                         |  |                            | CMMIs I | Interpretation | on        |             |              |               |              |       |          |      |         |      |     |     |   |
|                                    |  |                            |         |                |           |             |              | ML2           |              |       |          |      |         |      |     |     |   |
|                                    |  |                            | PP      | PMC            | M&A       | PPQA        | REQM         | SAM           | SD           | AM    | ARD      | SSAD | DAR     | OPD  | OPF | IPM |   |
| SGMM Levels                        | da ma di managanta   |                            |         |                |           |             |              |               |              |       |          |      |         | 11.0 |     |     | Ξ |
| Exploring & Initiating             | Developing first Smart Grid vision   |                            |         |                |           |             |              |               |              |       |          |      |         |      |     |     |   |
|                                    | Support for experimentation  |                            |         |                |           |             |              |               |              |       |          |      |         |      |     |     |   |
|                                    | Informal discussion with regulators  |                            |         |                |           |             |              |               |              |       |          |      |         |      |     |     |   |
|                                    | Funding likely out of existing budget  | -                          |         | -              | -         | -           |              |               | -            |       |          |      |         |      |     |     |   |
| Functional Investing               | Integrated vision and acknowledgement  |                            |         |                |           |             |              |               |              |       |          |      |         |      |     |     |   |
|                                    | Initial strategy and business plan approved  |                            |         |                |           |             |              |               |              |       |          |      |         |      |     |     |   |
|                                    | Initial alignment of investments to vision   |                            |         |                |           |             |              |               |              |       |          |      |         |      |     |     |   |
|                                    | Distinct Smart Grid Funding and budget created in collaboration with regulators and stakeholders |                            |         |                |           |             |              |               |              |       |          |      |         |      |     |     |   |
|                                    | Commitment to proof of concepts  |                            |         |                |           |             |              |               |              |       |          |      |         |      |     |     |   |
|                                    | Identify Initial Smart Grid leader   |                            |         |                |           |             |              |               |              |       |          |      |         |      |     |     |   |
| Integrating Cross Funct            | Completed Smart Grid strategy and business case incorporated into Corporate strategy             |                            |         |                |           |             |              |               |              |       |          |      |         |      |     |     |   |
|                                    | Smart Grid governance model deployed   |                            |         |                |           |             |              |               |              |       |          |      |         |      |     |     |   |
|                                    | Smart Grid leader(s) (with authority) ensure cross-LOB application                               |                            |         |                |           |             |              |               |              |       |          |      |         |      |     |     |   |
|                                    | Mandate/consensus with regulators to make and fund Smart Grid investments                        |                            |         |                |           |             |              |               |              |       |          |      |         |      |     |     |   |
|                                    | Corporate strategy expanded  |                            |         |                |           |             |              |               |              |       |          |      |         |      |     |     |   |
| Optimizing Enterprise V            | Smart Grid is a core competency that drives strategy and influences Corporate direction          | _                          |         |                |           |             |              |               |              |       |          |      |         |      |     |     |   |
|                                    | External stakeholders share in strategy  |                            |         |                |           |             |              |               |              |       |          |      |         |      |     |     |   |
|                                    | Willing to invest and divest, or engage in JV and IP sharing to execute strategy                 |                            |         |                |           |             |              |               |              |       |          |      |         |      |     |     |   |
| ▶ ► Strategy                       | , Management / Organization, Structure / Technology / Societal & Er                              | u sistem en tena en en des | 1 0     | Grid Ope       |           | A 188-0     | k & Asse     |               | conscioner.  | 1 000 | tomer Ma |      | ale a l |      |     | _   |   |



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|-----------------------|---------------------------|--|-------|---------|---|--------|--------|--------------|-----------|
| 1                     |                           | <u>To Index</u>                                      |       |         |   |        |        |              |           |
| 2                     | Chapter                   | Section  | _     |         | Requirements  | OSSP   | PIIDs  | Affirmations | Total 0   |
| 3                     | 4 General<br>Requirements |  |       |         |   |        |        | 0            | 0         |
| 4                     |                           | 4.1 Develop Your Quality<br>Management System (QMS)  | 1     |         |   | 0      |        | 0            | ) 0       |
|                       |                           |  | 4.1.1 |         | Establish your organization's QNS.  | 0.00   | 0.00   | 0.00         | 0.00      |
| 5<br>6<br>7<br>8<br>9 |                           |  | 4.1.2 |         | Document your organization's QMS.   | 0.00   | 0.00   | 0.00         | 0.00      |
| 7                     |                           |  | 4.1.3 |         | Implement your organization's QMS.  | 0.00   | 0.00   | 0.00         | 0.00      |
| 8                     |                           |  | 4.1.4 |         | Alaintain your organization's QMS.  | 0.00   | 0.00   | 0.00         | 0.00      |
| 9                     |                           |  | 4.1.5 |         | Improve your organization's QMS.  | 0.00   | 0.00   | 0.00         | 0.00      |
| 10                    |                           | 4.2 Document Your Quality<br>Management System (QMS) | 1     |         |   | 0      |        | 0            | 0         |
| 11                    |                           |  | 4.2.1 |         | Manage Quality Management System Documents  | a      | 0      | a            | a         |
| 12                    |                           |  |       | 4.2.1.1 | Develop documents for your organization's QMS.  | 0.00   | 0.00   | 0.00         | 0.00      |
| 13                    |                           |  |       | 4.2.1.2 | Make sure that your organization's QMS documents respect and reflect what you do and how you do it. | 0.00   | 0.00   | 0.00         | 0.00      |
| 14                    |                           |  | 4.2.2 |         | Prepare Quality Management System Manual  | a      | a      | а            | o         |
| 14                    |                           |  |       | 4.2.2.1 | Establish a quality manual for your organization.   | 0.00   | 0.00   | 0.00         | 0.00      |
| 16                    |                           |  |       | 4.2.2.2 | Maintain your organization's quality manual.  | 0.00   | 0.00   | 0.00         | 0.00      |
| 17                    |                           |  | 4.2.3 |         | Control Quality Management System Documents   | а      | a      | а            | a         |
| 17                    |                           |  |       | 4.2.3.1 | Control your organization's QMS documents.  | 0.00   | 0.00   | 0.00         | 0.00      |
| 19                    |                           |  |       | 4.2.3.2 | Control documents that are used as QMS records.   | 0.00   | 0.00   | 0.00         | 0.00      |
| 20                    |                           |  | 4.2.4 |         | Establish Quality Management System Records   | a      | a      | a            | a         |
| 14                    | ◆ ► ► CMMIs               | SPs Kobi CMMIs GPs                                   | IS    | O 900   | 01 2008 ISO 9001 Sum OHSAS 18001 2007 OHSAS 18001 2007 Sum ISO9000-3                                | SO9000 | -3 Sum | ISO IE       | C 27001 2 |
| 1                     |                           |  |       |         |   |        |        |              |           |



General Requirements

OHSAS 18001 2007

Realization Requirements

■ Management Requirements ■ Resource Requirements

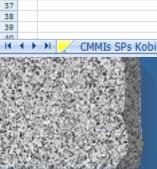
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ISO9000-3

ISO9000-3 Sum / ISO IEC 27

Remedial Requirements

OHSAS 18001 2007 Sum



34

35

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8.4 Collect and Analyze Quality Management Data

8.5 Make Improvements and Take Remedial Actions

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CMMIs GPs

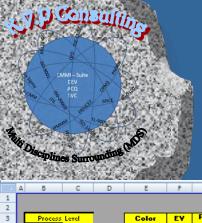
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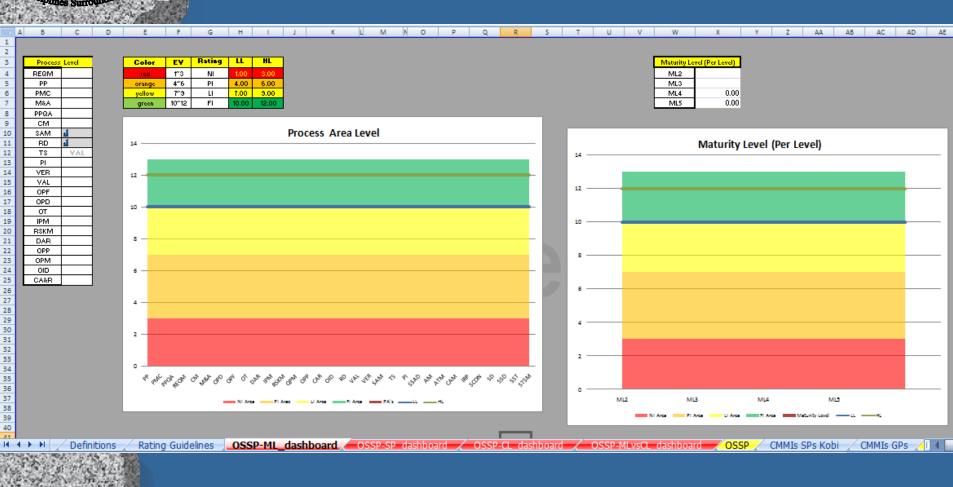
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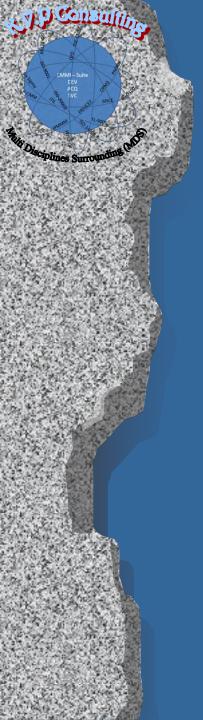
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ISO 9001 Sum







# Questions

## Lockheed Martin Aeronautics – Lockheed Martin Aero Standard Approach (LMASA)

10th Annual CMMI Technology Conference and User Group

November 15-18, 2010

Pam Hudson
Mike Freeman
Lockheed Martin Aeronautics

817-777-0773 <u>pamela.j.hudson@lmco.com</u> 817 935-4028 <u>michael.s.freeman@lmco.com</u>

## **Presentation Topics**



- Lockheed Martin Aeronautics Overview
- LMASA Overview
- Opening Brief Standard
- PIID Evidence Standard
- Conclusions

### Lockheed Martin Aeronautics Overview



## 29,000 employees across the company and around the world



### 2007 SCAMPI A Lessons Learned



- The 2007 SCAMPI A readiness strategy was man-power intensive
- The 3 day Introduction to CMMI course did not map to LM Aero terminology
- Including dynamic data in the PIID created problems
- Lack of common file structure across the program PIID repositories allowed for a convoluted mess
- Not restricting the file types included in the PIID was problematic
- Allowing duplication of artifacts within a program PIID created CM issues
- Significant planning did not prevent all network access issues for the appraisal team
- Comprehensive documented PIID archival process is important

PIID – Process Implementation Indicator Description CM – Configuration Management LM Aero – Lockheed Martin Aeronautics

## 2010 SCAMPI A Improvements

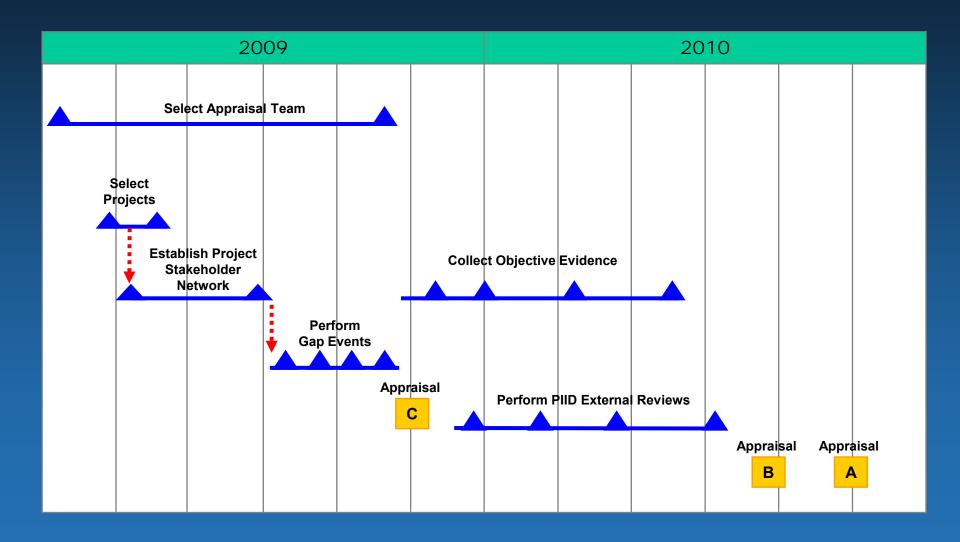


- A more centralized approach to program support was used
- More comprehensive use of "In-Briefings" to provide affirmations for Generic Practices reduced the artifacts required
- LMASA was refined to target more specific artifacts, based on the standard processes, resulting in less evidence required
- "Gap Events" were used to improve LMASA as well as program understanding of evidence needs
- The PIID Tool was changed to facilitate appraisal preparation:
  - Incorporation of LMASA Guidance into PIID Tool

LMASA – Lockheed Martin Aeronautics Standard Approach

## 2009 – 2010 Appraisal Planning Schedule





## **Presentation Topics**



- Lockheed Martin Aeronautics Overview
- LMASA Overview
- Opening Brief Standard
- PIID Evidence Standard
- Conclusions

# Lockheed Martin Aeronautics Standard Approach (LMASA) Overview



- LMASA provides unambiguous guidance to the appraisal projects in how LM Aero has decided to present our evidence to the SCAMPI team during our appraisal
- LMASA was initially developed for the 2007 SCAMPI to provide guidance for the CMMI Generic Practices
- In order to reduce cost for the 2010 SCAMPI, LMASA was expanded to all practices of the CMMI. It also was refined through extensive review to tightly align with our standard processes and their products.
- The 2007 SCAMPI A involved 3 appraisal projects, more than 100 participants, across 3 widely-dispersed sites collecting more than 3900 data items.
- The 2010 SCAMPI A involved five projects (two focus, three nonfocus) across the same three sites, but required only about 2600 data items

## **Presentation Topics**



- Lockheed Martin Aeronautics Overview
- LMASA Overview
- Opening Brief Standard
- PIID Evidence Standard
- Conclusions

### Opening Brief Standard





- Provide as many affirmations for GPs in the Opening Briefings as possible
- Developed a template for the projects to use for their Opening Briefings
  - Consistently addressed the GPs in each Program Opening Brief
  - Coordinated via cross-program dry runs

# Sample of Opening Brief Slide Covering GPs GP 2.2 Plan the Process



| Artifact  | ЬР | PMC | IPM | RSKM | REQM | RD | TS | Ы | VER | VAL | CM | PPQA | MA | SAM | DAR |
|---|----|-----|-----|------|------|----|----|---|-----|-----|----|------|----|-----|-----|
| Program Management<br>Plan                        | X  | X   | X   | X    |      |    |    |   |     |     | X  |      | X  | X   | X   |
| Systems Engineering Management Plan               |    |     |     |      |      |    | X  | X |     | X   | X  |      |    | X   |     |
| Configuration Management Plan                     |    |     |     |      |      |    |    |   |     |     | X  |      |    |     |     |
| Software Development Plan for the Mission Systems |    | X   |     |      |      |    | X  | X |     |     | X  |      |    |     |     |
| Requirements<br>Management Master Plan            |    |     |     |      | x    | X  |    |   |     |     |    |      |    |     |     |
| Requirements Work Package Concept of Operation    |    |     |     |      |      | X  |    |   |     |     |    |      |    |     |     |

## **Presentation Topics**



- Lockheed Martin Aeronautics Overview
- LMASA Overview
- Opening Brief Standard
- PIID Evidence Standard
- Conclusions

## Developed PIID Evidence Standard



- Reviewed the PIID evidence provided from all projects for the 2007 SCAMPI to develop stream-lined guidance for evidence for each practice for the 2010 SCAMPI
  - Identified specific work products that relate to LM Aero and the specific appraisal projects
  - Identified where evidence was needed for systems, software and hardware examples
- Reviewed the LMASA for every practice with the projects and the process owners in a series of "Gap Events"
  - Validated usability of LMASA
  - Improved the project 's understanding of what the 'best evidence' looked like
  - Determined what actions if necessary were needed to comply with LM Aero best practices embodied in the OSP
- Reviewed LMASA with Lead Appraiser and selected Appraisal Team Members during Class C Appraisal August 2009

### Structure of PIID Evidence Standard



- CMMI Identifiers
  - Process Area
  - Specific or Generic Practice (SP/GP)
  - Practice Number
- Explanation (Added)
  - Text to explain how the practice is implemented in the Aero environment
- Guidance (Refined)
  - The references to the Aero standard processes which address this practice were updated and made more explicit (typically to the paragraph level)
- Direct and Indirect Evidence (Refined)
  - Updated and tied more directly to work products identified in the Aero standard processes

# Samples from the PIID Evidence Standard



Process Area

Type (GP/SP)
Practice Number

Practice Statement

Explanation

Organizational Guidance

Direct Evidence Indirect Evidence

| PA 🛂 | Type 💌 | Practic | Statemen       | Explanation                                   | Organizational Guidance        | Direct evidence                   | Indirect Evidenc   |
|------|--------|---------|----------------|---|--------------------------------|-----------------------------------|--------------------|
| PP   | SP     | 1.2     | Establish and  | For Aero, the Capture Team will analyze the   | AC-5604, Plan and Baseline the | BOEs ("establish") and EACs       | Rationale section  |
|      |        |         | maintain       | technical solution to identify the program    | Program, 3.A.5.c ("establish") | ("maintain") showing the          | of BOE Forms       |
|      |        |         | estimates of   | attributes of work products and tasks that    |                                | generation of estimates based on  | showing identified |
|      |        |         | the attributes | will be used as the basis to estimate effort. | CPD-3032, Estimating and       | attributes of work products and   | attributes.        |
|      |        |         | of the work    | The Capture Team will then use the            | Pricing Process                | tasks; i.e., the estimation of    |                    |
|      |        |         | products and   | attributes of work products, tasks, and       |                                | attributes such as "Source Lines  |                    |
|      |        |         | tasks.         | technical requirements (reference CPD-3033,   |                                | of Code" or "engineering          |                    |
|      |        |         |                | Contract Technical Requirements, Proposal     |                                | drawings" which are then used to  |                    |
|      |        |         |                | Technical Requirements and CPD-3034,          |                                | develop estimates of cost and     |                    |
|      |        |         |                | Contract Technical Requirements-Proposal      |                                | schedule. These could be called   |                    |
|      |        |         |                | Planning) to develop the effort estimate in   |                                | "Task Sheets" or "Software Task   |                    |
|      |        |         |                | accordance with CPD-3032, Estimating and      |                                | Sheets". "Maintain" can also be   |                    |
|      |        |         |                | Pricing Process or AC-5631, Estimating and    |                                | shown by the collection of        |                    |
|      |        |         |                | Pricing Process. The resulting estimates and  |                                | metrics reflecting the attributes |                    |
|      |        |         |                | their rationale are documented in Basis of    |                                | used to generate the estimate in  |                    |
|      |        |         |                | Estimate (BOE) sheets.                        |                                | the BOE.                          |                    |
|      |        |         |                |   |                                |                                   |                    |

# PIID Evidence Standard- GP Example



- Example GP 2.2 Plan
  - Organizational Directive
    - One record that points to where in your process a plan is required (All PAs)
    - One record that points to Section 1.B of AC-5604 for the list of all plans, one of which is yours (even if it is not visible due to being part of another plan, such as the SEMP) (Project PAs only)
  - Program Directive = Organizational Directive
    - If you obtained a tailoring regarding your plan, create a record that shows that tailoring
  - Direct Evidence
    - A finalized, approved plan

# PIID Evidence Standard- GP Example



### CMMI Practice Report for CM GP 2.4

### CMMI Practice Info

Process Area: Configuration Management

Category: Support

The purpose of Configuration Management (CM) is to establish and maintain the integrity of work products using configuration identification, configuration control, configuration status accounting, and configuration

audits.

Go al GG 2 Institutionalize a Managed Process

The process is institutionalized as a managed process.

Standards for Direct and Indirect evidence

Practice: GP 2.4 Assign Responsibility

Assign responsibility and authority for performing the process, developing the work products, and providing the services of the configuration management process.

#### Example Direct Artifacts

LMASA: Program Management Plan establishing responsibility for CM by roles; Program Org Chart showing people assigned to CM roles (same as in GP 2.3)

CMM: • Documentation assigning responsibility for process activities, work products, or services; e.g., job descriptions, or plans for performing the process (see GP2.2).

Task descriptions and activities for defined roles.

#### Example Inderect Artifacts

LMASA: Affirmations from Program In-Brief.

CMMI: • Assignment is often in the project plan or configuration management plan

### Other contextual help

#### Appraiser Considerations

LMASA Organizational Guidance: AC-5604, Plan and Baseline the Program, 3 🗆 🗆 AC-5605, Organize the Program, 3.C, 3.D.5.e 🗆 🗆 AC-5607, Monitor and Control Program Performance

LMASA Considerations: For Aero, AC-5604 establishes responsibility for various elements of the program plan. AC-5605 specifically addresses the assignment of personnel for programs. Section 3.C describes the assignment of management personnel to the lowest tier. Section 3.D.5.e describes the assignment of personnel to roles within each PT to the various team members. Responsibilities, roles, and personnel assignments are covered in the Program Management Plan and the Program Organization Charts, as well as in IPT Charters.

CMIMI Considerations: • These activities may be distributed across different groups within the organization (e.g. systems, software, CM group).

Responsibility may change as development progresses across the life cycle.

Typical Work Products

# PIID Evidence Standard— SP Example PP SP 1.2



### Example Direct Artifacts

- LMASA: BOEs ('establish") and EACs ("maintain") showing the generation of estimates based on attributes of work products and tasks; i.e. the estimation of attributes such as "Source Lines of Code" or "engineering drawings" which are then used to develop estimates of cost and schedule. These could be called "Task Sheets" or "Software Task Sheets." "Maintain" can also be shown by the collection of metrics reflecting the attributes used to generate the estimate in BOE.
- Example Indirect Artifacts
  - LMASA: Rationale section of the BOE Forms showing identified attributes.

# PIID Evidence Standard- SP Example



### CMMI Practice Info

### CMMI Practice Report for PP SP 1.2

Process Area: Project Planning Category: Project Management

The purpose of Project Planning (PP) is to establish and maintain plans that define project activities.

Goal: SG 1 Establish Estimates

Estimates of project planning parameters are established and maintained.

Standards for Direct and Indirect evidence

Practice: SP 1.2 Establish Estimates of Work Product and Task Attributes

Establish and maintain estimates of the attributes of the work products and tasks.

#### Example Direct Artifacts

LMASA: BOEs ("establish") and EACs ("maintain") showing the generation of estimates based on attributes of work products and tasks; i.e., the estimation of attributes such as "Source Lines of Code" or "engineering drawings" which are then used to develop estimates of cost and schedule. These could be called "Task Sheets" or "Software Task Sheets". "Maintain" can also be shown by the collection of metrics reflecting the attributes used to generate the estimate in the BOE.

#### CMMI: [4. Attribute estimates]

- Estimates of the attributes of the work products and tasks (e.g., size)
- Estimates, as appropriate, of labor, machinery, materials, and methods that will be required by the project.

#### Example Indirect Artifacts

LMASA: Rationale section of BOE Forms showing identified attributes.

#### CMMI: [1. Technical approach]

- [2. Size and complexity of tasks and work products]
  [3. Estimating models]
- · Estimating tools, algorithms, and procedures
- Operational definitions (e.g., procedure/criteria) for establishing and documenting the estimates of the attributes of the work products and tasks.
- Bases of Estimates (BOEs)
- Use of validated models.
- · Use of models that are calibrated with historical data.

### Other contextual help

### i models.

### Estimates revision history.

Appraiser Considerations

LMASA Organizational Guidance: AC-5604, Plan and Baseline the Program, 3.A.5.c ("establish") CPD-3032, Estimating and Pricing Process

LMASA Considerations: For Aero, the Capture Team will analyze the technical solution to identify the program attributes of work products and tasks that will be used as the basis to estimate effort. The Capture Team will then use the attributes of work products, tasks, and technical requirements (reference CPD-3033, Contract Technical Requirements, Proposal Technical Requirements and CPD-3034, Contract Technical Requirements-Proposal Planning) to develop the effort estimate in accordance with CPD-3032, Estimating and Pricing Process Thursday, November 05, 2009

Page 1 of 2

Typical Work Products

Size and complexity of tasks and work products

Technical approach

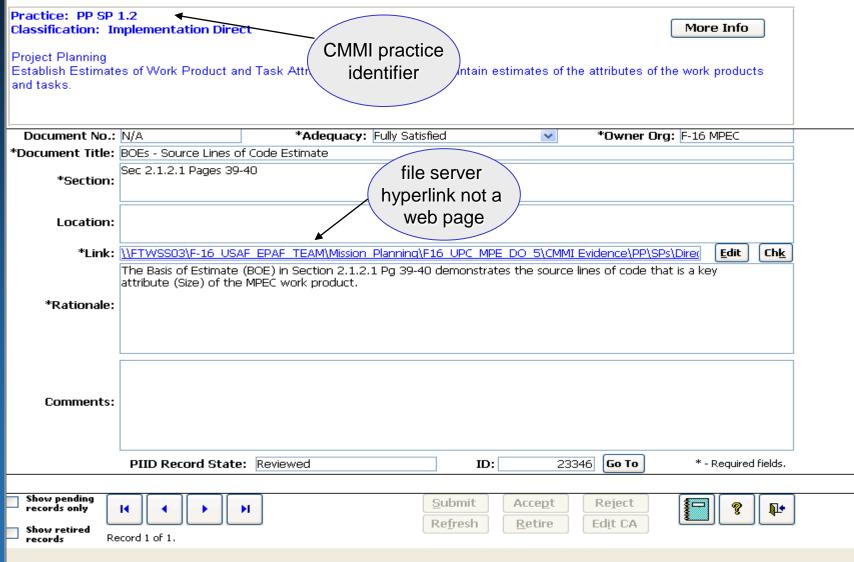
Estimating models

Attribute estimates

# PIID Repository Standard – Screen Shot from PIID Tool



### Practice Implementation Indicator Descriptions



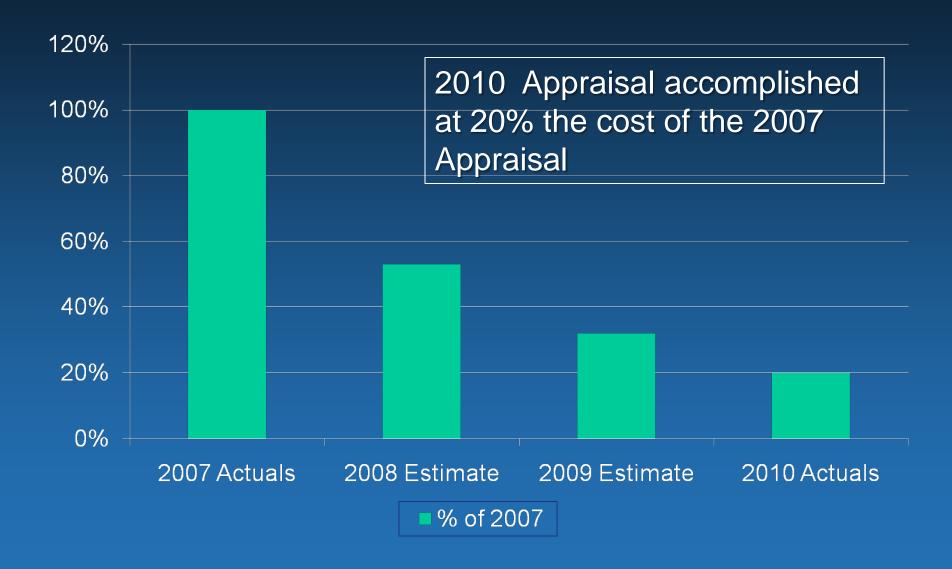
# **Presentation Topics**



- Lockheed Martin Aeronautics Overview
- LMASA Overview
- PIID Evidence Standard
- PIID Repository Standard
- Opening Brief Standard
- Conclusions

# Reduced Cost of Appraisal





### **Conclusions**



- Use of improved evidence collection tools and methods greatly reduced the cost of appraisal preparation
  - Initial estimate for preparation for 2010 appraisal was reduced to 52% of the cost of the 2007 appraisal
  - A later estimate for preparation for 2010 appraisal was reduced to 32% of the cost of the 2007 appraisal,
  - Actual cost of preparation for the 2010 appraisal was 20% of the actual cost for the 2007 appraisal, despite the inclusion of two additional projects
- Development of the LMASA also resulted in corrections and improvements to the standard processes
- Use of LMASA by the programs resulted in improved adherence to the standard process

# Questions?





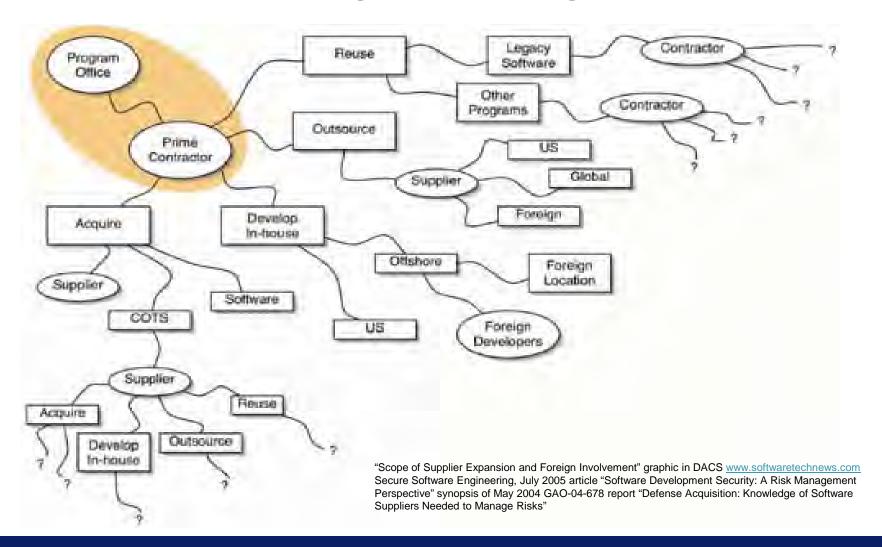
# Systems Assurance, The Global Supply Chain, and Efforts To Increase Communication Between Acquisition and Development

Michele Moss NDIA CMMI Technology Conference November 17, 2010

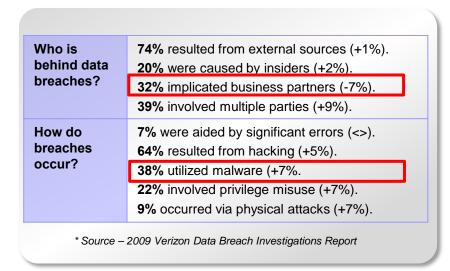
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- ▶ Globalization Challenges
- ▶ Understanding The Problem
- Working Towards A Solution

# Globalization brings challenges



# **Technology Is A Focal Point Of Attacks**



32%





According to an article in the May 2010 National Defense Magazine, well funded nation states and terrorist organizations are engaging in cyber attacks against US government systems. Examples of those include 44,000 Turkish teenagers in a military style community of hackers learning from each other.

There are also 100,000 hackers learning from each other in Saudi Arabia, 40,000 in Iraq, and over 400,000 in China.

# **Increased Priority for Program Protection**

- Threats: Nation-state, terrorist, criminal, rogue developer who:
  - Gain control of systems through supply chain opportunities
  - Exploit vulnerabilities remotely
- Vulnerabilities: All systems, networks, applications
  - Intentionally implanted logic (e.g., back doors, logic bombs, spyware)
  - Unintentional vulnerabilities maliciously exploited (e.g., poor quality or fragile code)
- ▶ Consequences: Stolen critical data & technology; corruption, denial of critical warfighting functionality

### Today's acquisition environment drives the increased emphasis:

| <u>Then</u>             |     | <u>Now</u>                              |
|-------------------------|-----|---|
| Standalone systems      | >>> | Networked systems                       |
| Some software functions | >>> | Software-intensive                      |
| Known supply base       | >>> | Prime Integrator, hundreds of suppliers |

Source: Source: September 28, 2010 SwA Forum, DoD Trusted Defense Systems, Ms. Kristen Baldwin, DDR&E/Systems Engineering

# "U.S. charges Florida pair with selling counterfeit computer chips from China to the U.S. Navy and military"

### INCIDENT:

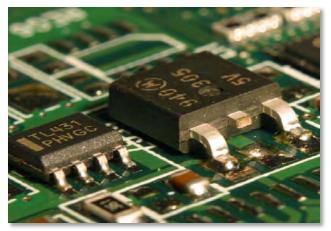
On September 14, 2010 Federal prosecutors in Washington unsealed charges accusing a Florida pair of selling more than 59,000 counterfeit computer microchips from China to the U.S. Navy and other clients for military use aboard American warships, fighter planes, missile and antimissile systems. Wren, owner of VisionTech Components and related companies, and McCloskey, an administrator, were charged with conspiracy, trafficking in counterfeit goods and mail fraud.

### **MITIGATION:**

In January the Commerce Department reported that the number of counterfeit incidents discovered by the military and its suppliers more than doubled between 2005 to 2008, to more than 9,356 cases. Meanwhile, lawmakers and congressional investigators have called on the Pentagon and law-enforcement agencies to combat the problem more aggressively.

### **IMPACT:**

The case marked the latest effort by U.S. authorities to stem the flow of fake electronics into the U.S. military supply chain, as warnings mount that fake chips could be defective or "electronic Trojan horses" that would allow hackers to disable them or track their use. Several recent government reports warn that computer chips marked with false brands or mislabeled as military-grade may include imperfections that could cripple or degrade weapons systems in combat or over time.



http://www.washingtonpost.com/wp-dyn/content/article/2010/09/14/AR2010091406468.html

Courtesy of Don Davidson, OSD TMSN , Chief of Outreach and Standardization

# "Recalled BlackBerry Batteries- Yet another wake-up call on counterfeit parts and product recall mitigation"

### INCIDENT:

On August 10, 2010 the U.S Consumer Product Safety Commission announced that about 470,000 BlackBerry batteries distributed by Asurion were being recalled due to an overheating and safety problem. According to the recall notice, the batteries in question were counterfeit, and "these batteries were used across virtually all modes of refurbished BlackBerry devices distributed by Asurion prior to November 1, 2009."

### **MITIGATION:**

Consumers who received refurbished BlackBerry devices through Asurion prior to November 1, 2009 were advised to immediately stop using the product and contact Asurion for a replacement product. Asurion is directly contacting known consumers with the affected batteries to notify them of this recall.

Courtesy of Don Davidson, OSD TMSN ,Chief of Outreach and Standardization

### **IMPACT:**

The counterfeit batteries can overheat, posing burn and fire hazards. Asurion has received two reports of counterfeit BlackBerry®-branded batteries overheating, causing minor burns to a consumer's finger and minor property damage to a sofa and car seat.



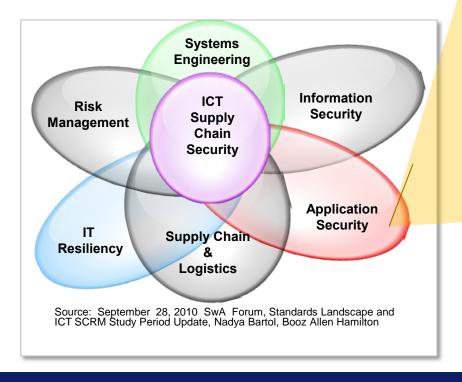
http://www.theferrarigroup.com/blog1/2010/08/11/recalled-blackberry-batteries-yet-another-wake-up-call-on-counterfeit-parts/

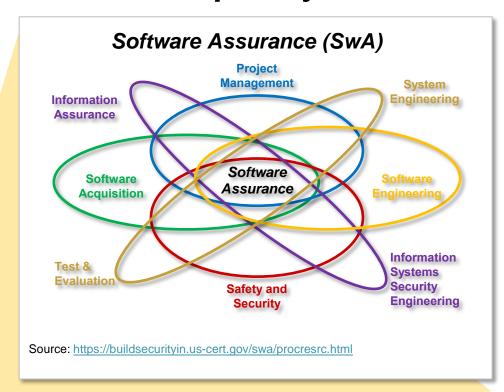
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ICT SCRM And SwA Are Complex Multi-Disciplinary

**Challenges** 





Filename/RPS Number 8

# Communication Across Organizational Stakeholders Is Critical to addressing ICT SCRM and SwA Challenges

**Define Business Goals** 

### **Development Organization**

DO 1 Establish the assurance resources to achieve key business objectives

DO 2 Establish the environment to sustain the assurance program within the organization

# Acquisition and Supplier Management

AM 1 Select, manage, and use effective suppliers and third party applications based upon their assurance capabilities.

### **Development Project**

DP 1 Identify and manage risks due to vulnerabilities throughout the product and system lifecycle

DP 2 Establish and maintain assurance support from the project

DP 3 Protect project and organizational assets

Prioritize funds and manage risks

### **Development Engineering**

DE 1 Establish assurance requirements

DE 2 Create IT solutions with integrated business objectives and assurance

DE 3 Verify and Validate an implementation for assurance

### **Enterprise Assurance Support**

ES 1 Establish and maintain organizational culture where assurance is an integral part of achieving the mission

ES 2 Establish and maintain the ability to support continued delivery of assurance capabilities

ES 3 Monitor and improve enterprise support to IT assets

Enable Resilient Technology Sustained environment to achieve business goals through technology

The Assurance PRM Is A Holistic Framework that connects CMMI and RMM to facilitate communication

https://buildsecurityin.us-cert.gov/swa/proself\_assm.html

# A Resilient Technology Best Practices Cross Walk

You have been asked to ensure that the OWASP Top Ten (an assurance coding Standard) are not in the Code

assurance objectives.

You can look at the OSAMM for guidance on how to do it

#### SwA Community's Assurance Process Reference Model - Initial Mappings In the following table ance" are intended to include system and software assurance, information assurance, and cybersecurity in support of the business/mission functions supported by systems and software. CMMI-SVC Goal AF CMMI **BSIMM** CMMI-ACQ CMMI-DEV RMM Practice RTSE:SG AF TS SP 1.1.1 ATM SG2 SATA SED1.1 Develop alternative solutions and selection criteria for TS SG1 1-SG2 mission and information assurance. KIM:SG2. AVAL SG2 SFD1.2 SA1B SG6 RTSE:SG AF TS SP 2.1.1 SFD2.1 ATM SG2 SA2A Architect for mission and information assurance. TS SG2 3 DE 2 Create IT solutions SFD2.3 AVAL SG2 TS SG2 SA2B with integrated business Design for mission and information assurance. AF TS SP 2.1.2 TS SG2 SFD2.1 objectives and assurance ament the mission and information, assurance AF TS SP 3.1.1 TS SG3 designs of the product components. RTSE:SG Identify deviations from mission and information CR1.4 AVER SG3 CR2A TS SG3 assurance coding standards. Implement appropriate AF TS SP 3.1.2 SE:SG mitigation to meet defined mission and information CR2.3 CR2B

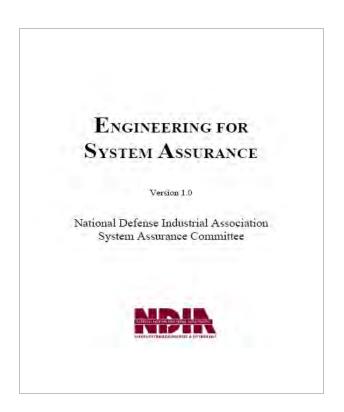
https://buildsecurityin.us-cert.gov/swa/proself\_assm.html

CR3.1

CR3A

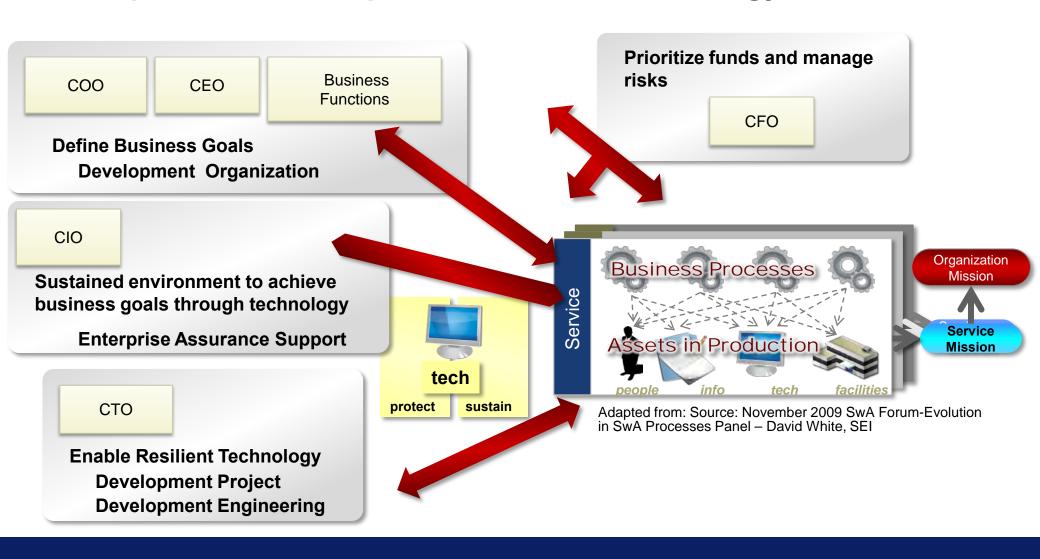
# Mapping to the Engineering for System Assurance, v1.0 is in progress

- NDIA/DoD guidebook providing process and technology guidance to increase the level of system assurance.
- Intended primarily to aid program managers (PMs) and systems engineers (SEs) who are seeking guidance on how to incorporate assurance measures into their system life cycles.

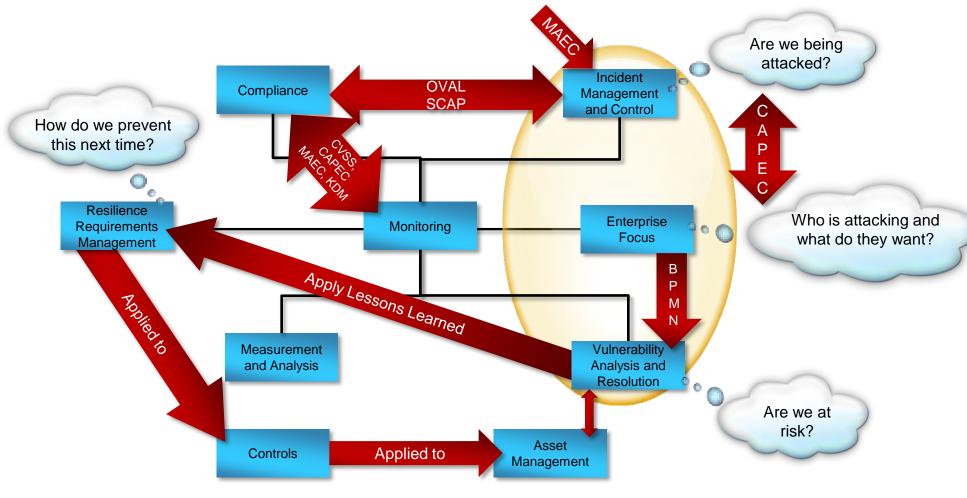


http://www.acq.osd.mil/sse/ssa/docs/SA-Guidebook-v1-Oct2008.pdf

# **Enterprise Leadership and Resilient Technology**



# SwA, SCRM, And Continuous Improvement Contribute To Operational Resilience



Adapted from September 2010 SwA Forum, CERT RMM for Assurance, Lisa Young, SEI

# ICT Supply Chain Assurance: An IATAC State-of-the-Art Report

The following link is available to personnel accessing from within a .mil or .gov domain:

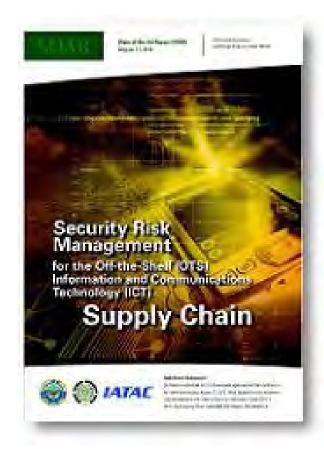
URL: <a href="http://iac.dtic.mil/iatac/pdf/supply\_chain.pdf">http://iac.dtic.mil/iatac/pdf/supply\_chain.pdf</a>

You may also contact IATAC directly to obtain access to this report. The easiest way for you and the IATAC team to get you the report is for you to

# Information Assurance Technology Analysis Center (IATAC)

Email: iatac@dtic.mil

URL: http://iac.dtic.mil/iatac/



# SAFECode (www.safecode.org)

- SAFECode is a global, industry-led effort to identify and promote best practices for developing and delivering more secure and reliable software, hardware and services
- White papers
  - Software Assurance: An Overview of Current Industry Best Practices
  - Fundamental Practices for Secure Software Development
  - Security Engineering Training: A Framework for Corporate Training Programs on the Principles of Secure Software Development
  - Framework for Software Supply Chain Integrity
  - Software Integrity Controls: An Assurance-Based Approach to Minimizing Risks in the Software Supply Chain



# **Describing the Software Supply Chain**

- Sophisticated IT solutions are composed of a collection of components
- ▶ Each component or its parts can be:
  - Developed by its supplier or on that supplier's behalf by their subcontractors; or
  - Licensed to the supplier by another vendor or obtained from Open Source repositories; or
  - Acquired outright by the supplier
- Regardless of the development scenario, each software supplier in the supply chain must manage three sets of controls:
  - Supplier Sourcing Select the suppliers, establish the specification for the supplier's deliverables, and receive software/hardware deliverables from the suppliers;
  - 2. Product Development and Testing Build, assemble, integrate and test components and finalize for delivery; and,
  - 3. Product Delivery Deliver and maintain their product components to their customer.

Source – SAFECode: Framework for Software Supply Chain Integrity

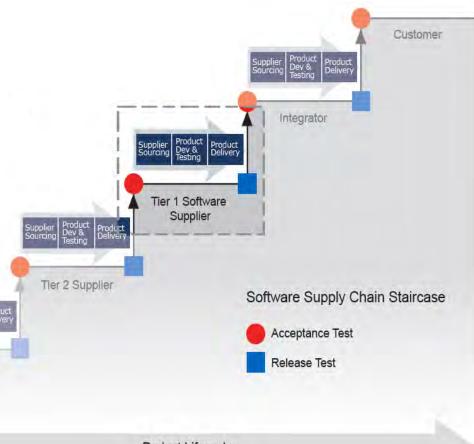


# **Software Supply Chain Staircase**

Figuratively, an IT solution supply chain can resemble a collection of staircases involving the successive transmission of software components from a supplier to its customer

In this figure, components move along the "staircase" supply chain as they are handed off from one supplier to the next. At each step a supplier controls three links in the supply chain:

- 1. Goods received from suppliers;
- 2. Their product production; and
- What is delivered to their customers



Project Lifecycles

Source - SAFECode: Framework for Software Supply Chain Integrity

# **Fundamental Software Supply Chain Integrity Controls**

- ▶ Software supply chain integrity controls address the access, storage and handling of development assets throughout the supply chain supplier sourcing, product development and testing, and product delivery.
- Some fundamental software supply chain integrity controls, derived from established security and integrity principles, include:

| Control Title                  | Description  |  |  |
|--------------------------------|--|--|--|
| Chain of Custody               | The confidence that each change and handoff made during the source code's lifetime is authorized, transparent and verifiable |  |  |
| Least Privilege Access         | Personnel can access critical data with only the privileges needed to do their jobs.   |  |  |
| Separation of Duties           | Personnel cannot unilaterally change data, nor unilaterally control the development process                                  |  |  |
| Tamper Resistance and Evidence | Attempts to tamper are obstructed, and when they occur they are evident and reversible.                                      |  |  |
| Persistent Protection          | Critical data is protected in ways that remain effective even if removed from the development location.                      |  |  |
| Compliance Management          | The success of the protections can be continually and independently confirmed  |  |  |
| Code Testing and Verification  | Methods for code inspection are applied and suspicious code is detected.   |  |  |

Source - SAFECode: Framework for Software Supply Chain Integrity

# **Software Sourcing Controls: Contractual**

- A vendor's engagement with a supplier is governed by a written agreement, for example a license or a contract
- ▶ The written agreement must explicitly state the vendors an supplier's expectations, as well as the consequences of any non-compliance with the terms of the agreement
- Software sourcing controls:
  - Defined Expectations Clear language regarding the requirements to be met by the code and the development environment should be set forth
  - Ownership and Responsibilities IC and responsibilities for protecting the code and development environment must be articulated
  - Vulnerability Response How well is the supplier equipped to collect input on vulnerabilities from reputable sources and appropriate remedies
  - Security Training How well is the partner able to effectively train its developers on security development practices
  - Open Source Software The use of OSS presents alternative challenges in the context of supply chain integrity

Source - SAFECode: Software Integrity Controls: An Assurance-Based Approach to Minimizing Risks in the Software Supply Chain



# **Software Sourcing Controls: Technical**

- Secure Transfer Delivered code should be transferred securely, using authenticated endpoints and encrypted sessions
- ▶ Sharing of System and Network Resources The digital identities a vendor issues to suppliers to enable access to the vendor's network and resources should be established with strong controls enforced to limit access to only those resources needed to perform the supplier's role

Sourcing

Procurement

- Malware Scanning Supplier content to be transmitted to the vendor should be scanned for malware using the most recent malware signature files and more than on commercial scanning engine
- Secure Storage Source code should be stored securely with need-to-know access controls applied
- ▶ Code Exchange Processes using digitally signed packages and verifiable checksums or hashes should be in place to ensure that received code is complete and authentic

Source - SAFECode: Software Integrity Controls: An Assurance-Based Approach to Minimizing Risks in the Software Supply Chain

Delivery

Software Development

Distribution

# **Software Development and Testing Controls: Technical**

People Security — Ensure that adequate background checks are performed, that roles and responsibilities and access rights are clearly defined, and that segregation of duties and controlled automated processes are applied.



- Physical security Building security and physical access control should be applied to development locations and code repositories and periodically re-assessed using a riskbased process
- Network Security Network security standards should be established and applied using a risk-based process for code-related assets
- ▶ Code Repository Security All code-related assets should be housed in source code repositories to enable additional attention to security and access control
- ▶ Build Environment Security Build environments should be as automated as much possible to minimize the opportunity for human intervention in the regular build process

Source - SAFECode: Software Integrity Controls: An Assurance-Based Approach to Minimizing Risks in the Software Supply Chain

# Software Development and Testing Controls: Security Testing

### ▶ Peer Review \ Manual Inspection —

 Are not often popular given issues of scalability, but automated tools can enable some scalability by collecting and processing more artifacts in preparation for peers performing a focused review



 Also, when teams are assigned to work together on code files, an important dynamic is present whereby reviewers can more readily identify code that does not belong within a code set

### ▶ Testing for Secure Code —

- The size of the code base for many software projects today requires automated code review and testing tools
- Building these tests to run in a repeatable automated manner increases the assurance that they will be performed and analyzed often
- These tools include: static code analysis tools, vulnerability scanners, binary code analysis tools, malware detection tools, security compliance validation tools, and code coverage tools

Source - SAFECode: Software Integrity Controls: An Assurance-Based Approach to Minimizing Risks in the Software Supply Chain

## Software Delivery Controls: Publishing and Dissemination

- Covers new product delivery and the delivery of maintenance patches
- Not always last stage of the supply chain
- As software components leave the supplier, software integrity and authenticity become a shared responsibility between the supplier and customer.



- ▶ Malware Scanning Products should be scanned for malware using the most recent malware signature files and more than one commercial scanning engine
- Code Signing The software vendor's product should be strongly digitally marked with the software vendor's identity in a way that can't be altered, yet may be verified by the customers
- Delivery A vendor's process for delivering products both online and through distributions using physical and electronic media should be secured; information on code signing and checksums should be available to customers.
- Transfer Vendors should transfer products in such a way that the receiver can confirm that the product is coming from the software vendor Source - SAFECode: Software Integrity Controls: An Assurance-Based Approach to Minimizing Risks in the Software Supply Chain

## **Software Delivery Controls: Authenticity**

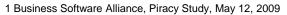
- Over one in five software packages is counterfeit or pirated<sup>1</sup>
- Authenticity is a core element of software assurance
- ▶ The risk of counterfeit software can be greatly reduced through purchase from only authorized resellers, careful examination of product packaging and media, and technology to notify user when they
- and media, and technology to notify user when they may be the victim of counterfeit software

Software

Sourcing

Procurement

- Cryptographic Hashed or Digitally Signed Components digitally signed components or checksum hashes are an essential authenticity control to prove that components are genuine
- ▶ Notification Technology Vendors can leverage technology to detect certain aspects of the product's integrity and notify the user if the software is deemed to be counterfeit.
- ▶ Authentic Verification During Program Execution the practice of verification when the application is installed on a computer; each time the application runs, the integrity of the files is verified



Source - SAFECode: Software Integrity Controls: An Assurance-Based Approach to Minimizing Risks in the Software Supply Chain

Software

Delivery

DistributionSustainment

Software Development

and Testing

Environment

# **Software Delivery Controls: Deployment and Sustainment**

- The software life cycle extends beyond delivery of the initial software vendor's product and into the product's sustainment or maintenance phase.
- As a result, patches and hot fixes should be subject to the same software integrity controls as the original code



- Only authorized service personnel with ongoing access to genuine parts and proper disposal procedures should be involved in the sustainment process
- ▶ Secure Configurations Whenever possible, software vendors should ship products with a secure configuration being set as the default configuration
- ▶ Custom Code Extensions Integrators must follow secure development practices as they extend code functionality through the provided secure interfaces

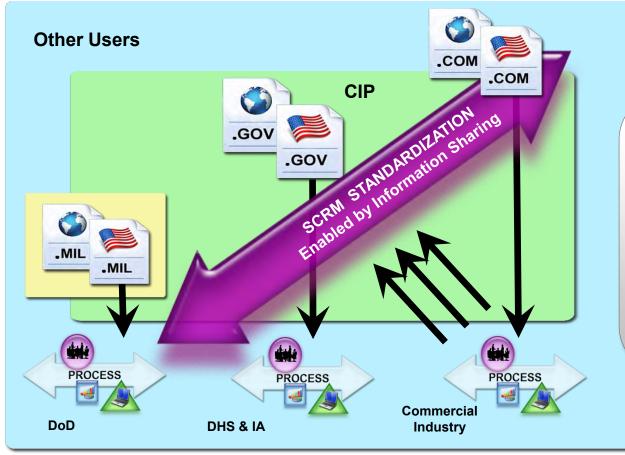
1 Business Software Alliance, Piracy Study, May 12, 2009

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### **SCRM Stakeholders**

US (CNCI) has vital interest in the global supply chain.



SCRM "commercially acceptable global standard(s)" must be derived from Commercial Industry Best Practices.

SCRM Standardization Requires Public-Private Collaborative Effort

Courtesy of Don Davidson, OSD TMSN , Chief of Outreach and Standardization

### Major Efforts being executed by DDRE/SE

- Implementing 5200.39 and 5000.02 Program Protection Policy
  - Review/Coordination of PPPs for ACAT I programs
  - Program protection assessment methodology
  - Guidance and best practice countermeasures, education and training, industry outreach, to assist programs with CPI identification and protection
- Supply Chain Risk Management
  - Procedures, capability to utilize threat information in acquisition
  - Commercial standards for secure components (ISO/IEC, The Open Group)
- Horizontal Protection Procedures
  - Acquisition Security Database (ASDB) oversight and implementation

- Advancing the practice: Systems Security Engineering
  - SERC Research Topic "Security Engineering"
  - INCOSE Working Group on Systems Security Engineering
  - DoD/NSA Criticality Analysis Working Group
- DoD Anti-Tamper Executive Agent
  - Anti-Tamper IPT, AT policy, guidance advocate
  - Legislative Proposal Defense Exportability Fund Pilot Program
- Countering Counterfeits Tiger Team
  - Lifecycle strategy to reduce counterfeits, especially microelectronics

Source: Source: September 28, 2010 SwA Forum, DoD Trusted Defense Systems, Ms. Kristen Baldwin, DDR&E/Systems Engineering

## The Open Group Trusted Technology Provider Framework (TTPF)

#### **Purpose**

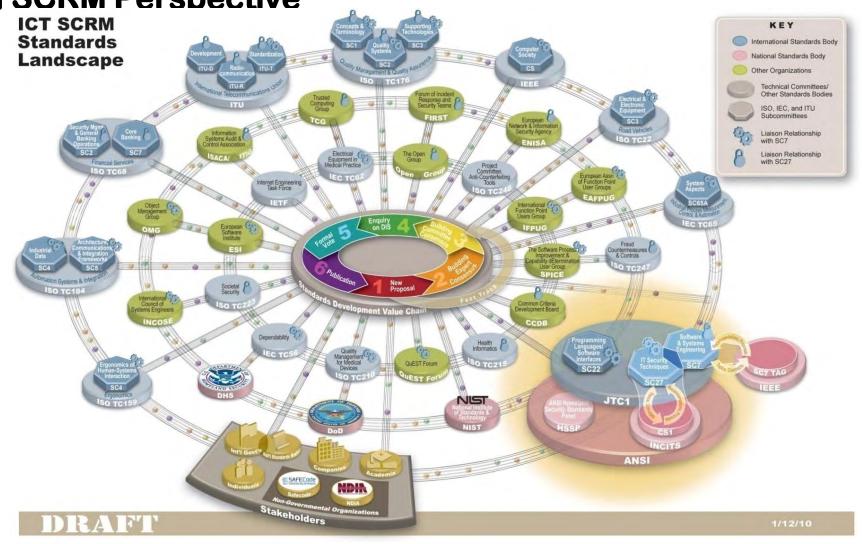
Identify and gain consensus on common processes, techniques, methods, product and system testing procedures, and language to describe and guide product development and supply chain management practices that can mitigate vulnerabilities which could lead to exploitation and malicious threats to product integrity.

#### Objectives

- Identify product assurance practices that should be expected from all commercial technology vendors based on the baseline best practices of leading trusted commercial technology suppliers
- Help establish expectations for global government and commercial customers when seeking to identify a trusted technology supplier
- Leverage existing globally recognized information assurance practices and standards
- Share with commercial technology consumers secure manufacturing and trustworthy technology supplier best practices
- Harmonize language used to describe best practices

Source: Source: September 28, 2010 SwA Forum, DoD Trusted Defense Systems, Ms. Kristen Baldwin, DDR&E/Systems Engineering

Standards Development Organizations Landscape: an SCRM Perspective



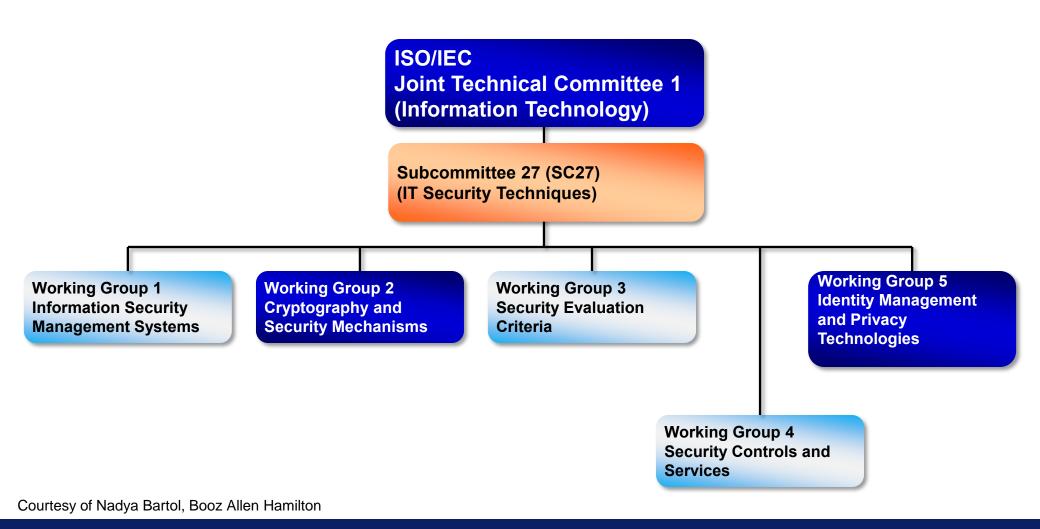
Courtesy of Don Davidson, OSD TMSN , Chief of Outreach and Standardization

### **CS1 ICT SCRM Ad Hoc Group**

- ▶ Established in February 2009
- Joint with SC7 TAG
- Substantial industry and government participation
- Contributed to several new and under revision standards
- ▶ Developed consensus-based USNB proposal for ICT Supply Chain Assurance Standard

Courtesy of Nadya Bartol, Booz Allen Hamilton

### ISO/IEC JTC1 SC27 focuses on IT Security Techniques



### What is the Problem and Gaps We Are Trying to Address?

#### **Problem**

- Information and Communication Technology (ICT) products are assembled, built, and transported by multiple vendors around the world before they are acquired without the knowledge of the acquirer
- Abundant opportunities exist for malicious actors to tamper with and sabotage products, ultimately compromising system integrity and operations evidenced by multiple recently publicized incidents (counterfeit hardware sold to government agencies)
- Organizations acquiring hardware, software, and services are not able to understand and manage the security risks associated with the use of these products and services

#### Need

- Provide a common language for addressing the problem
- Provide a resource that would help acquirers articulate requirements to product and service providers and monitor implementation in a recognizable manner that is vetted internationally
  - Increase confidence in acquired products and services from security risk point of view
  - Create a common language to articulate expectations regarding security risks associated with product and service acquisition
- Provide a resource that would help product and service providers demonstrate responsible practices, regardless of where they are located

Courtesy of Nadya Bartol, Booz Allen Hamilton

## ISO/IEC 27036: Information technology – Security techniques – Information Security for Supplier Relationships (proposed title)

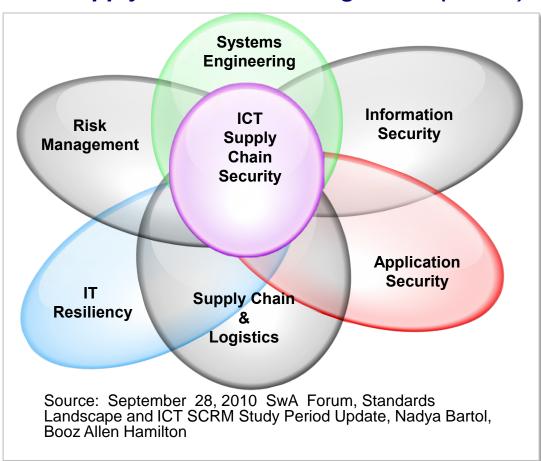
- ▶ Scope: This international standard covers information security in relationships between acquirers and suppliers to provide appropriate information security management for all parties. In particular, it also includes management of information security risks related to these relationships.
- ▶ The standard will be subdivided into the following parts:
  - Part 1 Overview and Concepts
  - Part 2 Common Requirements
  - Part 3 Guidelines for ICT Supply Chain
  - Part 4 Guidelines for Outsourcing
- Relevant Documents to be considered
  - Management Systems: ISO/IEC 27000 family; ISO 28000, Supply Chain Resiliency; ISO/IEC 20000, IT Service Management
  - Risk Management: ISO 31000, ISO/IEC 27005, and ISO/IEC 16085
  - Lifecycle Processes and Practices, software acquisition, and software assurance ISO/IEC/IEEE 15288 (systems), ISO/IEC/IEEE 12207 (software), IEEE 1062 (software acquisition), ISO/IEC15026 (software assurance)
  - ISO TMB NWIP on Outsourcing

Courtesy of Nadya Bartol, Booz Allen Hamilton

#### What's next?

- Participate in SC7 TAG intersections through your SC7 TAG
- Participate through your IEEE representative to the SC7 TAG
- Participate through the SwA Working Groups and Forum
- Stay Tuned ...

#### ICT Supply Chain Risk Management (SCRM)



## Back-up

#### https://buildsecurityin.us-cert.gov/swa/proself\_assm.html

The DHS SwA Processes and Practices Working Group has synthesized the contributions of leading government and industry experts into a set of high-level goals and supporting practices (an evolution of the SwA community's Assurance Process Reference Model)

The goals and practices are mapped to specific industry resources providing additional detail and real world implementation and supporting practices

- Assurance Focus for CMMI
- Building Security In Maturity Model
- Open Software Assurance Maturity Model
- •CERT® Resilience Management Model
- •CMMI for Acquisition
- •CMMI for Development
- •CMMI for Services
- •SwA Community's Assurance Process Reference Model –Initial Mappings
- •SwA Community's Assurance Process Reference Model Self Assessment
- •SwA Community's Assurance Process Reference Model Mapping to Assurance Models

#### Other valuable resources that are in the process of being mapped include

- •NIST IR 7622: DRAFT Piloting Supply Chain Risk Management Practices for Federal Information Systems
- •NDIA System Assurance Guidebook
- Microsoft Security Development Lifecycle
- SAFECode





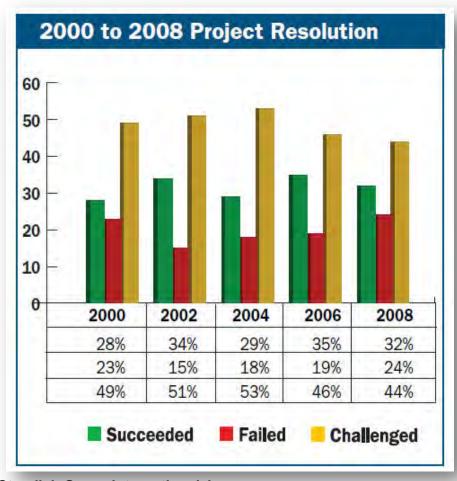
### Agenda

- Framing the Issue Why did we develop the AVP ?
- AVP Overview
- CMMI & The AVP
- Q&A





### Software project success continues to decline...



2006 - 2008

Cost Overruns 7%

Time Overruns 7%



The Standish Group International, Inc. 2009 CHAOS Summary 2009



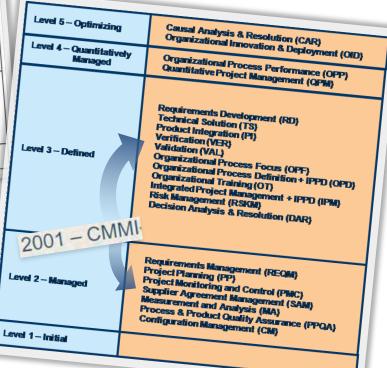
### How much do you waste on rework – every year?

| Number of  | Your Annual   | Your Annual Waste |
|------------|---------------|-------------------|
| Developers | People Cost   | on Rework         |
| 30         | \$3,000,000   | \$1,200,000       |
| 50         | \$5,000,000   | \$2,000,000       |
| 100        | \$10,000,000  | \$4,000,000       |
| 200        | \$20,000,000  | \$8,000,000       |
| 300        | \$30,000,000  | \$12,000,000      |
| 500        | \$50,000,000  | \$20,000,000      |
| 1000       | \$100,000,000 | \$40,000,000      |
| 3000       | \$300,000,000 | \$120,000,000     |



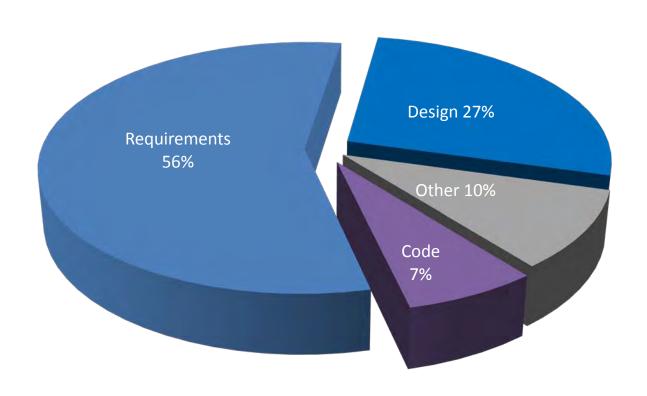
#### We've been talking about Requirements for a very long time...

|                           |  | Key Process Areas  |
|---------------------------|--|--|
| The state of              | Focus  | - Defect Prevention  |
| Level 5<br>Optimizing     | Continuous process improvement                   | - Technology Change Management - Process Change Management   |
| Level 4                   | Product and process quality                      | - Software Quality Management  |
| Managed  Level 3  Defined | Engineering processes and organizational support | Organization Process Detriment     Training Program     Integrated Software Management     Software Product Engineering     Intergroup Coordination  |
| Level 2<br>Repeatable     | Project management processes                     | Requirements Management     Software Project Planning     Software Project Tracking and Oversight     Software Subcontract Management     Software Quality Assurance     Software Configuration Management |
| Level 1                   |  | tware CMM  |





...and still can't get it right –
Software Development time wasted (Rework)





### **Analyst Perspectives**

Gartner.

#### Requirements Form the Foundation of Software Quality

26 March 2009

Thomas E. Murphy

Gartner RAS Core Research Note G00165755

Development and testing teams can't effectively deliver software without appropriate requirements. Best practices and tools can drive improved quality and productivity.

Overview

A large number of defects are injected into software when the requirements are collected, but the defects aren't detected until the testing phase. Involving the quality assurance (QA) team in requirement reviews can detect and remove a high percentage of these defects, improving project efficiency and reducing costs.

#### **Key Findings**

- Finding and fixing defects during the development of the requirements is more than six times more cost-effective than doing so during the development phase.
- Requirement defects remain a large percentage of defects, and cause IT versus business friction.
- Communication defects are driven out by better requirement-eliciting practices.
- · Involving the QA organization in a sign-off review leads to early defect detection and better testing.

#### Recommendations

- · Before implementation begins, establish QA-driven requirement reviews.
- To minimize rework costs, invest in improving the quality of requirements.
- . To reduce communication errors, use newer requirement-eliciting tools and prototyping with short cycles.



### Sample cost savings from earlier attention to quality

| Cost of            | Requirements | Design  | Development | Testing   | Production  | Resolution cost for 100 |
|--------------------|--------------|---------|-------------|-----------|-------------|-------------------------|
| problem resolution | 1x           | 2x      | 10x         | 50x       | 100x        | defects at \$100/defect |
| %<br>resolved      | 0%           | 0%      | 0%          | 0%        | 100%        |                         |
| cost               | \$0          | \$0     | \$0         | \$0       | \$1,000,000 | \$1,000,000             |
| %<br>resolved      | 10%          | 0%      | 0%          | 60%       | 30%         |                         |
| cost               | \$1,000      | \$0     | \$0         | \$300,000 | \$300,000   | \$601,000               |
| %<br>resolved      | 10%          | 40%     | 25%         | 20%       | 5%          |                         |
| cost               | \$1,000      | \$8,000 | \$25,000    | \$100,000 | \$50,000    | \$184,000               |

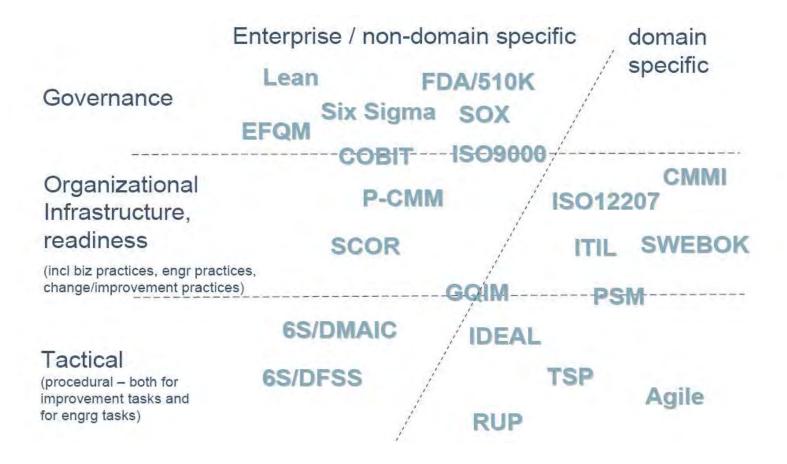


### Why Do a Value Profile

- Understand Current Capabilities
  - Where do you stand in the basic SDLC disciplines ?
  - What progress have you made?
- Compare Capabilities with Industry Norms
  - Where do other companies stand?
- Understand Business and Economic Implications
  - What are your Critical Business Issues ?
  - What is the economic impact of the CBI gaps?
  - What is the value of closing the CBI gaps ?
- Determine a Strategy for Improvement
  - What is the long-term vision?
  - Which improvement steps are you ready for?
  - Where should you focus your efforts in the short term



### **Industry Models**





### What are we doing in an AVP?

#### 1) Business Issues

Regulations & Compliance Customer Satisfaction Feature Implementation Application Development Costs Time to Market

#### 2) Financials

| Application Development Budget | \$1,500,000 |
|--------------------------------|-------------|
| Development Staff              | 50%         |
| Project Management             | 10%         |

#### 3) Processes

| Test Environment Preparation |  |      |
|------------------------------|--|------|
| Test Environments            | Dedicated test environments are made available in a timely manner to cover different deployment environments | 4096 |
| Privacy                      | All data populating the test environments follow Corporate policies for data<br>privacy, SOX, HIPAA, etc.    | 1096 |

#### 4) Value of Improvement

| Sources of Business Value |           |  |
|---------------------------|-----------|--|
| Lower Costs               | \$252,332 |  |
| Higher Quality            | \$87,293  |  |
| Faster Time to Market     | \$50,194  |  |
| Better Business Alignment | \$100,660 |  |
| Total                     | \$490,479 |  |

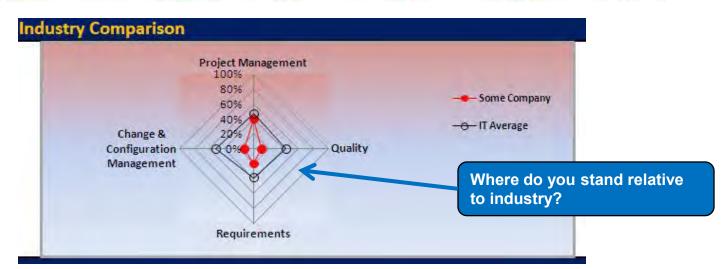


#### **Process Analysis**

#### **Capability Profile**

|                                   | Repeatability       | Precision                         | Visibility/Controlled        | <b>Optimized</b>   |
|-----------------------------------|---------------------|-----------------------------------|------------------------------|--------------------|
| Project Management                | Foundational Phases | Phase Management                  | Risk Management              | Governance         |
| 40%                               | 45%                 | 60%                               | 34%                          | 20%                |
| Quality                           | Quality Control     | Quality Assurance                 | Quality Management           | Quality Governance |
| 10%                               | 13%                 | 13%                               | 7%                           | 7%                 |
| Change & Configuration Management | Essentials          | Planning and Change<br>Management | Activity/Asset<br>Management | Governance         |
| 13%                               | 8%                  | 19%                               | 19%                          | 7%                 |
| Requirements                      | Document Focused    | Stability Focused                 | Alignment Focused            | Total RDM Focused  |
| 20%                               | 42%                 | 10%                               | 9%                           | 20%                |

**Current Capability?** 





#### **Business Value of Improvement**

#### **Projected Value of Improved Capability Cumulative Annual Business Value** What is the potential value \$1,400,000 ■ Value Opportunity (\$1,332,541) of SPI? \$1,200,000 \$1,000,000 Improvement Value \$800,000 Phase 1 \$490,479 \$600,000 Phase 2 \$257,942 Phase 3 \$305,922 \$400,000 Phase 4 \$85,999 \$200,000 \$62,146 Phase 5 50 \$130,052 Phase 6 Phase 6 Phase 1 Phase 2 Phase 3 Phase 4 Phase 5 \$1,332,541 Total

#### Phase One

| Sources                   | of Business Value |           |
|---------------------------|-------------------|-----------|
| Lower Costs               | 51.45%            | \$252,332 |
| Higher Quality            | 17.80%            | \$87,293  |
| Faster Time to Market     | 10.23%            | \$50,194  |
| Better Business Alignment | 20.52%            | \$100,660 |
| Total                     | 100.00%           | \$490,479 |

What is the potential value of a Phase 1 improvement program?



## AVP Supports: CMMI Infrastructure Institutionalization

- Institutionalization means that the process is ingrained in the way the work is performed: "That's the way we do things around here."
- The organization builds an infrastructure that contains effective, usable, and consistently applied processes (e.g., GP 2.3)

#### GP 2.3: Provide Resources

Provide adequate resources for performing the <x> process, developing the work products, and providing the services of the process.



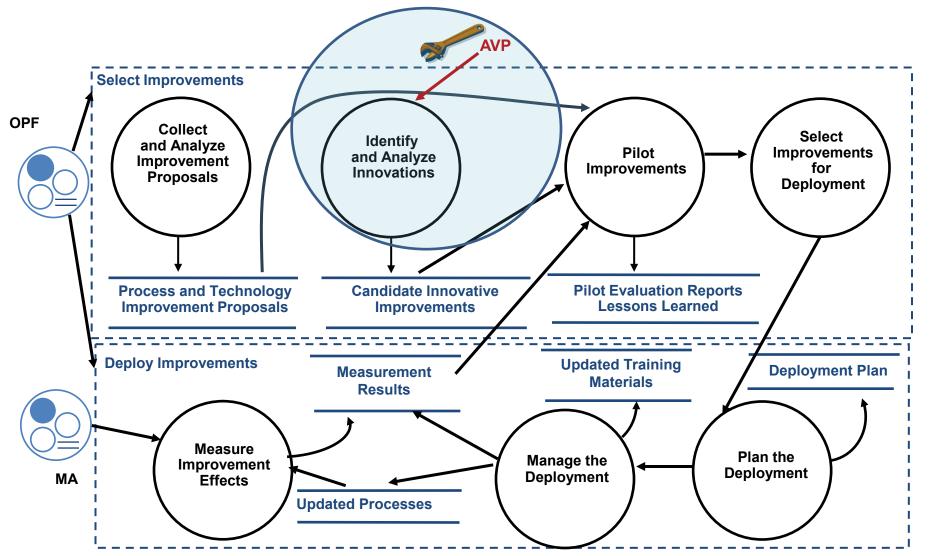
### The "Value" of AVP during CMMI Appraisals

With AVP, a detailed analysis on capability is created to help support "GP 2.3 – Provide Resources" from a holistic view in knowing what are your gaps/strengths and what technology improvements could be helpful in supporting the specific process areas.

|  |                     |  | $\overline{/}$ |
|--|---------------------|--|----------------|
| GG1: Achieve Specific Goals                                  | GP 1.1:             | Perform Specific Practices   |                |
| GG2: Institutionalize a<br>Managed Process                   | GP 2.1:<br>GP 2.2:  | Establish an Organizational Policy Plan the Process                                |                |
|  | GP 2.3:<br>GP 2.4:  | Provide Resources  Assign Responsibility   |                |
|  | GP 2.5:<br>GP 2.6:  | Train People  Manage Configurations  |                |
|  | GP 2.7:<br>GP 2.8:  | Identify and Involve Relevant Stakeholders  Monitor and Control the Process        |                |
|  | GP 2.9:<br>GP 2.10: | Objectively Evaluate Adherence Review Status with Higher Level Management          |                |
| GG3: Institutionalize a Defined Process                      | GP 3.1:<br>GP 3.2:  | Establish a Defined Process Collect Improvement Information                        |                |
| GG4: Institutionalize<br>a Quantitatively Managed<br>Process | GP 4.1:<br>GP 4.2:  | Establish Quantitative Objectives for the Process Stabilize Subprocess Performance |                |
| GG5: Institutionalize an Optimizing Process                  | GP 5.1:<br>GP 5.2:  | Ensure Continuous Process Improvement Correct Root Causes of Problems              |                |



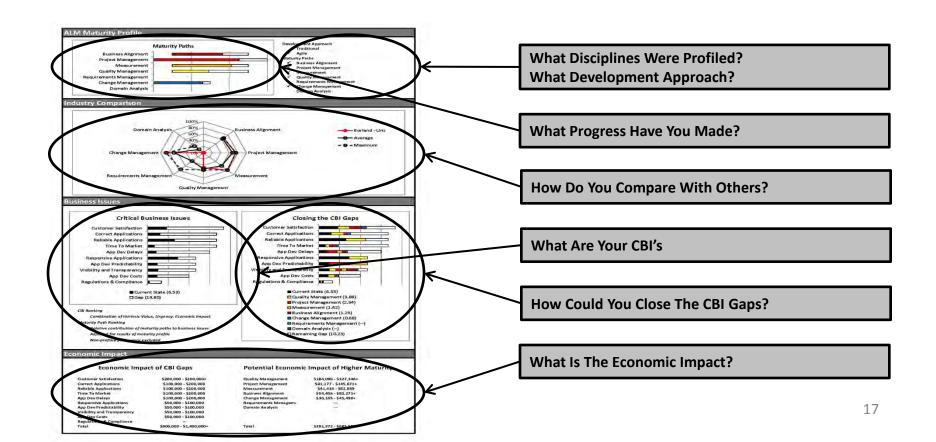
### **AVP Supports Identifying Possible Innovations**





### The Relationship of AVP ← OID

For those organizations targeting to define and deploy high maturity practices within their organization, the AVP enables an even stronger implementation of Organizational Innovation and Deployment (OID) practices especially surrounding the "active" search outside the organization's IT domain. Basically, OID's specific practice (SP) 1.2 "Identify and Analyze Innovations" is fully optimized to increase the organization's quality and process performance.





### **Example: The Economic Opportunity**

- Organization with \$7M annual development budget
- \$850k projected annual benefit
- Just by optimizing requirements definition & management







LOCKHEED MARTIN

Pittsburgh, PA 15213-3890

### CMMI V1.3 High Maturity Panel

# WE THOUGHT BUT NOW WE KNOW

M. Lynn Penn Lockheed Martin Information Systems & Global Services

**Rawdon Young**Software Engineering Institute

Alice Perry Raytheon





### **Presentation Agenda**

#### **TWO PARTS**

WE THOUGHT

Background – how we got here

2. WE KNOW

**CMMI V1.3 High Maturity Process Areas** 



## The Challenge



**High Maturity CMMI V1.3** 



### **High Maturity Starting Point**

The High Maturity Team is composed of veterans of the V1.2A workshop – note the majority are from high maturity organizations in industry.

- Lynn Penn (LMCO) Lead
- Dan Bennett (AF)
- Will Hayes (SEI)
- Rick Hefner (NG)
- Jim Kubeck (LMCO)
- Alice Parry (Raytheon)
- Kathy Smith (HP)
- Rusty Young (SEI)

Use of the high maturity redline of CMMI for Development and change requests submitted against it has added another layer of complexity to the analysis of change requests.

- Assumption CMMI Dev V1.2 is baseline
- Assumption CMMI Dev V1.2A (redlines) is a CR



### **High Maturity Issues**

- Terminology Confusion
- •Requirements implied versus explicit
- Explanations not central or consistent
  - Model/ Audit Criteria/ Presentations (Healthy Ingredients)/ UCHMP
- Perceptions
  - Customers ML 5 is expensive no better than 3
  - Industry ML 5 is NOT RIGHT for every business
- High Maturity in ALL constellations
  - Examples are focused on Development



#### **Terminology Confusion**

- Common Cause
  - Statistical versus QuantitativeTechniques
- Process Models and Process Modeling
- Business Objectives
- Subprocesses



# Requirements Explicit Explanations not central

Two issues really one

- Goal:
  - Sunset OTHER explanations
    - Incorporate Healthy ingredients as appropriate goals/ practices
    - Audit Criteria Audit to Model and MDD include what is necessary



#### **Perceptions**

Individual based... However recommended

#### HIGH MATURITY RESTRUCTURING

- Insufficient link between process improvement, business objectives, and performance
- Clarify distinction between ML4 and ML5
- Eliminate GG4 and GG5
- CMMI V1.3 Webnar Suggestions (not covered elsewhere)
  - Clarify role of OID and CAR
  - Make CAR more relevant/ clarification in role



## **High Maturity Pre-Review**

#### **High Maturity Review at SEPG**

- Invited individuals which include HMLA/ Potential HM Pilot companies to a special session at the NA SEPG
  - Rusty and Lynn presented the HM Team intentions and introduction to the HM PAs (including the new OPM PA)
  - Provided these same individuals with the redlines for HM including a high level OPM (GLOP)
  - Asked for the following actions:
    - Within 1 week provide HMT with a heads up or down on changes
    - Within 2 weeks provide HMT with redlines to the redlines



## **High Maturity SEPG Results**

- Approximately 150 individuals were invited
- Approximately 45 individuals attended
- •Received feedback at conference positive on intentions and direction we were pursuing
- •Received heads up/ down feedback from 6 individuals
  - One of these was not at presentation so took many emails to explain
  - The feedback was more questions not in keeping with initial SEPG positive feedback
  - Four of these individuals have also provided redlines



## **High Maturity Team Consensus**

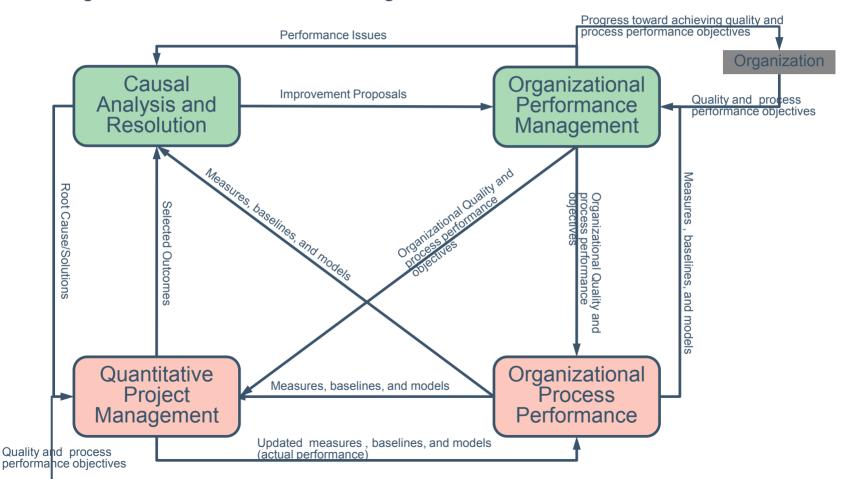
- •Team members that attended SEPG were positive and very upbeat about questions and follow up
- Observations after feedback
  - Discouraged that so few responded
  - A few comments showed a mis-understanding of existing HM and an inability to grasp anything different
- Team Position
  - Clean up existing PAs (some relevant comments)
  - Complete OPM generation
  - Proceed to "Open Team" review





Combined OPM/ OID – 1 ML5 PA Organizational Performance Management

Improvements





#### **High Maturity PAs Relationships 1**

#### **Organizational Process Performance (OPP)**

- Clarified relationship between OPP and rest of high maturity process areas
- Clarified that process performance baselines and models can be created and used in at levels and not just the organizational level

#### **Quantitative Project Management (QPM)**

- Restructured to a prepare for quantitative management and quantitatively manage the project or work.
- Emphasized the use of statistical <u>and</u> other quantitative techniques
- Emphasized that quantitative management covered managing subprocesses through the project levels (from the micro through the macro levels)



#### **High Maturity PAs Relationships 1**

#### O<sub>I</sub>quantitative management

Managing a project or work group using statistical and other quantitative techniques to build an understanding of the performance or predicted performance of processes in

comparison to the project's or work group's quality and process performance objectives, and identifying corrective action that may need to be taken. (See also "statistical techniques") Statistical techniques used in quantitative management include analysis, creation, or use of process performance models, analysis, creation, or use of process performance baselines; use of control charts; analysis of variance, regression analysis; and use of confidence intervals or prediction intervals, sensitivity analysis,

simulations, and tests of hypotheses.

quantitatively manufacture the project or work.

- Emphasized that quantitative management covered managing subprocesses through the project levels (from the micro through the macro levels)
- Emphasized the use of statistical <u>and</u> other quantitative techniques

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#### **High Maturity PAs Relationships 1**

#### statistical and other quantitative techniques

Analytic techniques that enable accomplishing an activity by quantifying parameters of the task (e.g., inputs, size, effort, and performance). (See also "statistical techniques" and "quantitative management.") This term is used in the high maturity process areas where the use of statistical and other quantitative techniques to improve understanding of project, work, and organizational processes is described. Examples of non-statistical quantitative techniques include trend analysis, run charts, Pareto analysis, bar charts, radar charts, and data averaging. The reason for using the compound term "statistical and other quantitative techniques" in CMMI is to acknowledge that while statistical techniques are expected, other quantitative techniques can also be used effectively

through the macro

Emphasized the use of statistical and other quantitative techniques



#### **High Maturity PA Relationships 2**

#### **Causal Analysis and Resolution (CAR)**

- Made it clearer when to use statistical and other quantitative techniques.
- Clarified use by projects AND organizations to perform causal analysis and resolution on selected outcomes.
- Updated to include positive and negative outcomes not just defects.
- Modified outputs from CAR to include Improvement Proposals to feed process improvements to the organization's set of standard processes (OPM).

#### **Organizational Performance Management (OPM)**

- Focused the Process Area on managing business performance to achieve quality and process performance objectives.
- Added a Specific Goal that requires organizations to use measures, process-performance baselines and models from OPP to understand process performance, target areas for continuing improvement, and evaluate the impact of proposed improvements.
- Made it clear that statistical and other quantitative techniques are used to evaluate and select improvement proposals and to evaluate whether the improvement achieved expected performance improvement.



#### **Organizational Process Performance**

- Restructured OPP moving "Establish Quality and Process Performance Objectives to SP 1.1 for emphasis.
- Revised SP 1.4 to include process performance analysis and assessment of subprocess stability.
- Revised SP 1.5 to clarify process performance models are used throughout the development lifecycle toward achieving quality and process performance objectives.
- Clarified that not all process performance baselines and models must be created at the organization level. Projects can follow OPP practices to create process performance baselines and models, when appropriate.
- Clarified the relationship of OPP to other high maturity process areas.
- Emphasized traceability to business objectives through modifications to SP1.1 and SP1.2



#### **Quantitative Project Management**

- Restructured QPM so that SG1 focuses on preparation and SG2 focuses on managing the project.
- Broadened the focus on using statistical techniques from individual selected subprocesses to cover multiple levels from the individual subprocesses to the entire project.
- Added guidance about using process performance baselines and process performance models.
- Defined quantitative management in the glossary to include statistical techniques and used that definition for use of the terms throughout QPM.
- Modified the practice to remove the emphasis on applying statistical methods to understand variation to reduce the overemphasis on control charts.
- Added new practices about managing performance and performing root cause analysis.



#### **Causal Analysis and Resolution**

- Used "outcomes" to include positive outcomes instead of only "defects and problems."
- Added examples for service organizations and for selecting outcomes for analysis.
- Added subpractices in SP 1.1 for defining the problem, and in SP 2.2 for following up when expected results were not realized.
- Added more information about how PPMs can be used.
- Added informative material addressing more proactive defect prevention.



# Organizational Performance Management

- Expanded the former OID PA to include performance management and called it Organizational Performance Management (OPM) to emphasize focus on performance of the organizational processes as they relate to business objectives.
- Defined a new goal about managing business performance using statistical and other quantitative techniques.
- Clarified that improvements selected for possible implementation can be validated in different ways, piloting is not the only option.
- More explicitly described the use of process performance models.
- Provided more information about how improvements can be selected for deployment.
- Changed references from "process and technology improvements" to "improvements", with an explanation that improvements include both.

Pittsburgh, PA 15213-3890

#### **Questions?**

# Pilot for CMMI-DEV V1.3 High Maturity Process Areas

**Lockheed Martin IS&GS-Defense** 

**NDIA 11/17/10** 



Scott Foster Dorna Witkowski

### **Agenda**

1

- Background
- Purpose of Pilot
- Streamlined Structure of Pilot
- Summary of Results



## **Background – IS&GS-Defense**

- Lockheed Martin IS&GS—Defense
  - Employs over 12,000 people at more than 200 sites encompassing over 400 programs worldwide
  - Is principally engaged in the design, development, operation and sustainment of systems and solutions that help our defense customers achieve their missions
  - <u>Headquarters:</u> Valley Forge, PA
  - <u>Customer Base:</u> The majority of IS&GS-Defense's business is with the U.S. Department of Defense, other U.S. government customers and the military services of international governments.

# 1

## **Background – IS&GS-Defense**

- In January 2009 IS&GS-Defense achieved a CMMI Maturity Level 5 based on the Staged CMMI Dev V1.2 + IPPD
  - Organization and 3 large programs assessed:
    - \* Advanced Extremely High Frequency (AEHF) Mission Control Segment (MCS) - develops and deploys the MCS which will consist of upgrades and replacement of the existing fielded MILSTAR equipment and software to support the combined MILSTAR and AEHF constellation of satellites.
      - Size: 348 People, Development
      - Locations: King of Prussia, PA; Denver, CO; San Jose, CA; Rockville, MD
    - \* Space Based Infrared System (SBIRS) High, Ground Segment develops software to replace the ground segments of the US satellite Early Warning System.
      - Size: 368 People, Development
      - Location: Boulder, CO; Sunnyvale, CA
    - Integrated Space Command and Control (ISC2) program provides a powerful, yet flexible platform for current and emerging space, air, and missile defense missions.
      - Size: 388 People, Development
      - Location: Colorado Springs, CO

\* Also participated in V1.3 Pilot

# **Background – High Maturity Process Areas of V1.3**

- Planning for the pilot was initiated on the March 2010 GLOP High Maturity Redline
  - Causal Analysis & Resolution (CAR) updated
    - Change from "Defects and Problems" to "Outcomes" (good or bad)
  - Organizational Innovation & Deployment (OID) updated
    - Differentiation between incremental and innovative improvements
  - Organizational Performance Management (OPM) was added
    - New process area to manage the process performance of the organization
  - Organizational Process Performance (OPP) updated
    - Change to order of specific practices to help understanding of intent
    - Rewrite of selection of processes and sub-processes
  - Quantitative Project Management (QPM)
    - Modification of order of specific practices to help understanding of intent
    - Clarification of analysis of project performance
- Used this version as the baseline for the pilot
  - Did not change direction even when OPM was combined with OID to form a combined OPM

The assumption was that V1.3 updates did not levy <u>new</u> requirements, only reinforced the *intent* of the high maturity concepts

### **Purpose of Pilot**



- Provide feedback to the Software Engineering Institute (SEI) on the updated language within the model
- Ensure the company and its programs were consistently performing at a Maturity Level 5
- Identify any potential disconnects between the company's plans and processes and the updated model
  - Ensure that the organization understood and was consistent with the new wording
  - Help new leaders in process positions feel more comfortable with the plans for a re-appraisal
- Piloted new PIID tool developed by the organization



# 1

#### **Streamlined Structure of Pilot**

- Chose a Class B method
- Only assessed High Maturity Process Areas
- Used discovery mode for QPM and CAR
  - Programs provided easily available evidence for review (standard business rhythm work products)
  - No program preparation time required
  - Used artifacts from programs that were focus programs in the 2009 SCAMPI A
- Required PIIDS for specific practices of organizational process areas only
  - OPP, OID, OPM
  - No objective evidence for generic practices
- Used an experienced appraisal team
  - Both previously on SCAMPI A for the organization
- Conducted interviews virtually



# 4

# **Summary of Results – Feedback** to the **SEI**

- Full agreement with eliminating GG4 and GG5
- Full agreement on greater emphasis on Process Performance Baselines and Models
  - Recommended greater emphasis in the informative material for ML5
     PAs
- Partial agreement on adding a new OPM process area
  - ½ of team felt it wasn't needed and didn't add real value
  - $\frac{1}{2}$  of team felt it helped tie the relationship between OID and OPP
- Full agreement with including positive as well as negative outcomes for CAR
- Mild agreement with de-emphasizing "common cause" as a differentiator between ML4 and ML5
  - Most people did not have an opinion
- Agreement on broadening "statistical management"
- Agreement on restructuring QPM

# Summary of Results – Performance of Organization against the V1.3 PAs (1)

- Results were provided as risks:
  - Low risk of meeting CMMI goals on the right track, but still work to do
  - Medium risk of meeting CMMI goals actions need to be taken to stay on track
  - High risk of meeting CMMI goals off track; need to re-assess program or organizational activity
- Additional meetings held after the Final Briefing to explain results in detail

# Summary of Results – Performance of Organization against the V1.3 PAs (2)

- General Strengths:
  - Management support of the pilot
    - Both in concept, time of participants and follow-up after the results
  - Organization and Programs have Goal-to-Measure Mappings that show the threads from high level business goals to actual measurements used
- General Weaknesses:
  - Difficulty in articulating how the term "Quality and Process Performance Objectives" related to standard activities
  - Participants were not in "appraisal" mode
    - Even though most had been in appraisals before
    - Had to be reminded not to assume the appraisers knew how they operated

# Summary of Results – Performance of Organization against the V1.3 PAs (3)

- Program Process Areas were low risk
  - Evidence easily available to show compliance with QPM and CAR
  - Programs were being managed quantitatively and improvements were tied to program goals
  - But program personnel needed to be able to better verbalize threads and quantitative results
- OPM was low risk
  - Business needs and goals were established
  - Improvements were based on goals
  - Needed to articulate the "Quality and Process Performance Objectives"

Updates to QPM and CAR had no impact on programs OPM turned out to be a "no brainer"

# Summary of Results – Performance of Organization against the V1.3 PAs (4)

- OPP was medium risk
  - New organizational participants needed to learn to "tell the story"
    - To tie together the various aspects of high maturity
  - This observation was driven by the model's emphasis on traceability to business objectives
  - New order of OPP did not affect results
- OID was medium risk
  - Business needs and goals were established
  - More emphasis on quantitative results in model will drive more emphasis on quantitative results in the evidence

Updates to OPP and OID helped focus organization on future actions

### **Summary of Results – PIID Tool**

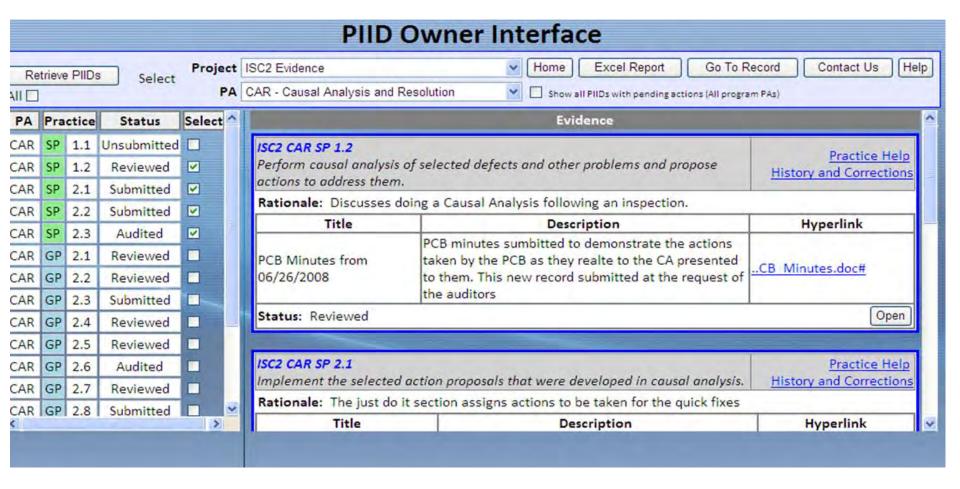
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- PIID tool used to review evidence for Organizational PAs
- Evidence Review Feedback
  - Allow review comments in the tool
  - Allow partial satisfaction without failing the record/practice
  - Allow information requests without failing record/practice
  - Show all evidence for a PA at a glance
- Evidence Entry Feedback
  - Allow easy transfer between Direct and Indirect
  - Show what evidence has been submitted for entire Practice

All of the feedback has been addressed in the latest version

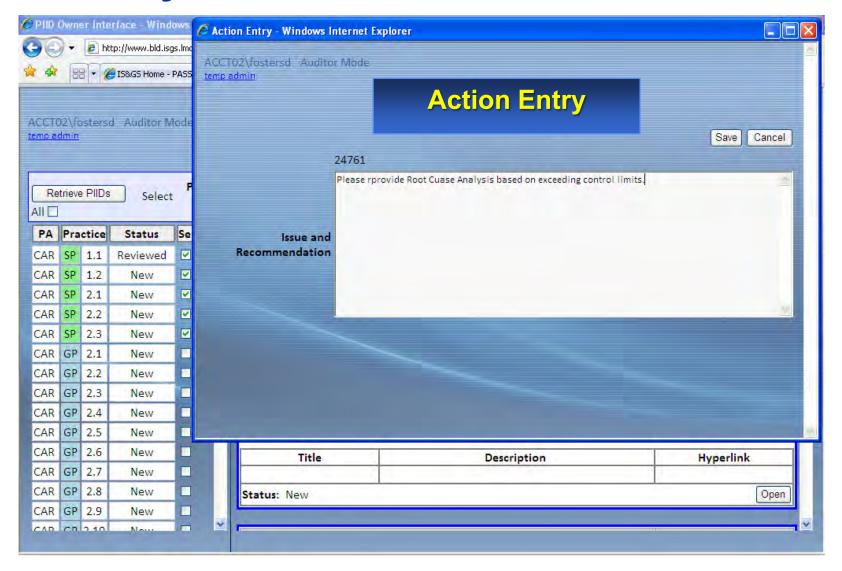


### **Summary of Results – PIID Tool**





### **Summary of Results – PIID Tool**



### **Summary**



- Pilot helped organization do a "mid-course" correction
  - Helped to understand emphasis in the next version of the model
  - Generated actions to ensure high maturity activities remain focused
- Pilot helped establish a usable and flexible PIID tool for future appraisals
- SCAMPI B on all organizational process areas scheduled for January 2011 with V1.3







### Comparing Scrum And CMMI How Can They Work Together

**Neil Potter** 

The Process Group help@processgroup.com www.processgroup.com



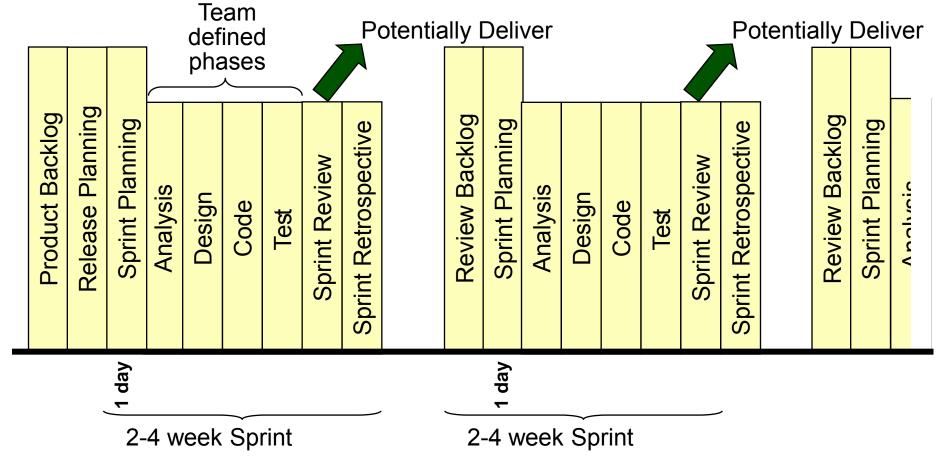
## **Agenda**

- Definition of Scrum
- Agile Principles
- Definition of CMMI
- Similarities and Differences
- CMMI and Scrum Mapping
- How About Other Components of Level 2?
- How About Level 3?
- Summary



#### **Definition of Scrum**

 Scrum is a pre-defined development lifecycle based on Agile principles.





## Agile Principles - 1



Our highest priority is to satisfy the customer through early and continuous delivery of valuable software.



Welcome changing requirements, even late in development. Agile processes harness change for the customer's competitive advantage.



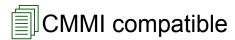
Deliver working software frequently, from a couple of weeks to a couple of months, with a preference to the shorter timescale.



Business people and developers must work together daily throughout the project.



Build projects around motivated individuals. Give them the environment and support they need, and trust them to get the job done.



Source: http://agilemanifesto.org/



## Agile Principles - 2



The most efficient and effective method of conveying information to and within a development team is face-to-face conversation.



Working software is the primary measure of progress.



Agile processes promote sustainable development. The sponsors, developers, and users should be able to maintain a constant pace indefinitely.



Continuous attention to technical excellence and good design enhances agility.



Simplicity -- the art of maximizing the amount of work not done--is essential.



The best architectures, requirements, and designs emerge from self-organizing teams.



At regular intervals, the team reflects on how to become more effective, then tunes and adjusts its behavior accordingly.



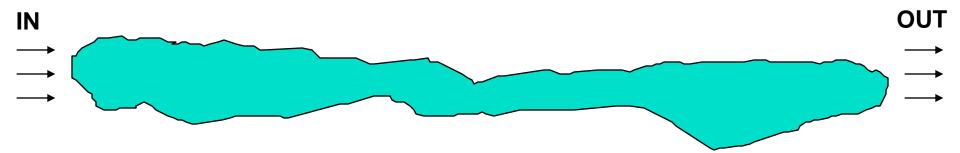
### **Definition of CMMI** v1.2

| Level                       | Focus                                | Process Areas   | Quality      |
|-----------------------------|--------------------------------------|---|--------------|
| 5 Optimizing                | Continuous<br>Process<br>Improvement | Organizational Innovation and Deployment Causal Analysis and Resolution   | Productivity |
| 4 Quantitatively<br>Managed | Quantitative<br>Management           | Organizational Process Performance<br>Quantitative Project Management   |              |
| 3 Defined                   | Process<br>Standardization           | Requirements Development Technical Solution Product Integration Verification Validation Organizational Process Focus Organizational Process Definition +IPPD Organizational Training Integrated Project Management +IPPD Risk Management Decision Analysis and Resolution |              |
| 2 Managed                   | Basic<br>Project<br>Management       | Requirements Management Project Planning Project Monitoring and Control Supplier Agreement Management Measurement and Analysis Process and Product Quality Assurance Configuration Management   | Risk         |
| 1 Initial                   |                                      |   | Rework       |

- CMMI is a collection of practices that an organization (software, hardware and IT) can adopt to improve its performance.
- Maturity Level 2
   Process Areas focus on change and project management.
- Maturity Level 3
   focuses on
   engineering skills,
   advanced project
   management and
   organizational
   learning.



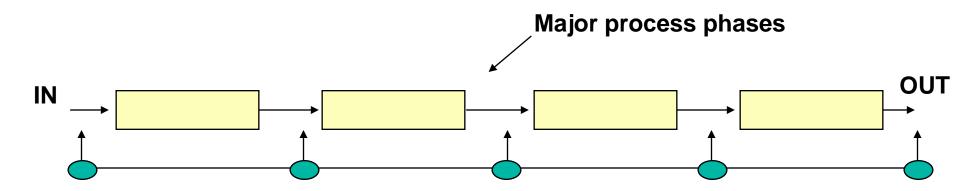
### Visibility Into the Process Level 1



- Process is an amorphous entity
- Visibility into the project's process is limited
- Difficult to establish the status of the project's progress and activities



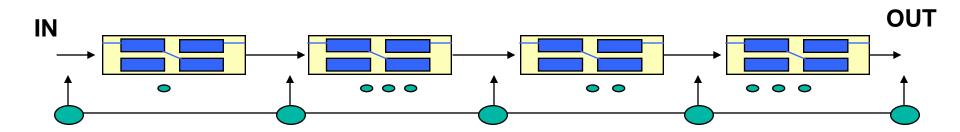
### Visibility Into the Process Level 2



- Customer requirements and work products are controlled
- Basic project management practices have been established
- Management controls allow visibility into the project on defined occasions
- Management reacts to problems as they occur



### Visibility Into the Process Level 3

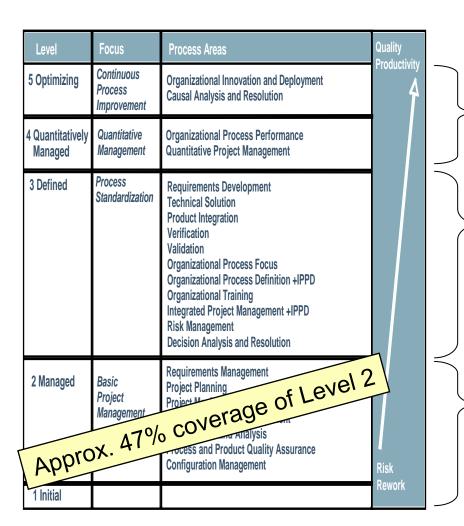


- · Tasks in the project's defined process are visible
- Accurate and rapid status updates are available
- Management proactively prepares for risks that may arise



### **Similarities and Differences**

### In Scrum?



• No

Level 3 coverage - very dependent on how YOU define the phases

- Some requirements
- Some design
- Coding
- Some test
- Some lessons learned
- Most Requirements Management
- Most Project Planning
- Most Project Monitoring/Control
- Most Measurement Analysis (effort and progress)



## **CMMI** and **Scrum** Mapping



## Requirements Management

| REQM   | CMMI Practice  | Scrum Practice   |
|--------|--|--|
| SP 1.1 | Develop an understanding with the requirements providers on the meaning of the requirements. | Review of Product Backlog (requirements) with Product Owner and team.  |
| SP 1.2 | Obtain commitment to the requirements from the project participants.                         | Release Planning and Sprint Planning sessions that seek team member commitment.  |
| SP 1.3 | Manage changes to the requirements as they evolve during the project.                        | <ul> <li>Add requirements changes to the Product Backlog.</li> <li>Manage changes in the next Sprint Planning meeting.</li> </ul>  |
| SP 1.5 | Identify inconsistencies between the project plans and work products and the requirements.   | <ul> <li>Daily Standup Meeting to identify issues.</li> <li>Release planning and Sprint Planning sessions to address inconsistencies.</li> <li>Sprint Burndown chart that tracks effort remaining.</li> <li>Release Burndown chart that tracks story points that have been completed. This shows how much of the product functionality is left to complete.</li> </ul> |

### No traceability in Scrum

[SP 1.4 Maintain bidirectional traceability among the requirements and work products]



## **Project Planning**

| PP     | CMMI Practice   | Scrum Practice  |
|--------|---|---|
| SP 1.1 | Establish a top-level work breakdown structure (WBS) to estimate the scope of the project.          | The standard tasks used in a Scrum process combined with specific project tasks (Scrum Backlog).  |
| SP 1.2 | Establish and maintain estimates of the attributes of the work products and tasks.                  | Story Points, used to estimate the difficulty (or relative size) of a Story (requirement).  |
| SP 1.3 | Define the project life-cycle phases upon which to scope the planning effort.                       | The Scrum process.  |
| SP 1.4 | Estimate the project effort and cost for the work products and tasks based on estimation rationale. | Scrum Ideal Time estimate (similar to billable hours or Full-time Equivalents).   |
| SP 2.1 | Establish and maintain the projectÕsbudget and schedule.  | <ul> <li>Scrum estimates (in Ideal Time).</li> <li>Estimates of what work will be in each release.</li> <li>Sprint Backlog.</li> <li>Project Taskboard.</li> </ul>  |
| SP 2.4 | Plan for necessary resources to perform the project.  | <ul> <li>Scrum estimates in Ideal Time</li> <li>Release Plan, Sprint Backlog and assignments.</li> </ul>  |
| SP 2.6 | Plan the involvement of identified stakeholders.  | <ul> <li>Scrum process roles (including team, Scrum Master, Product Owner).</li> <li>[Note: The stakeholders listed in Scrum might not be the complete list of stakeholders for the project, e.g., customers, other impacted teams.]</li> </ul> |
| SP 3.2 | Reconcile the project plan to reflect available and estimated resources.                            | <ul><li>Sprint Planning meeting.</li><li>Daily Scrum meeting.</li></ul>   |



## **Project Monitoring and Control**

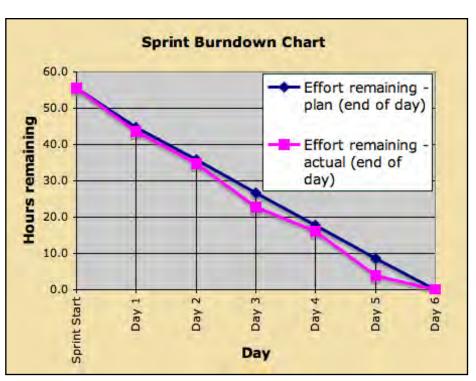
| PMC    | CMMI Practice  | Scrum Practice  |
|--------|--|---|
| SP 1.1 | Monitor the actual values of the project planning parameters against the project plan. | <ul> <li>Sprint Burndown chart that tracks effort remaining.</li> <li>Release Burndown chart that tracks completed story points. This shows how much of the product functionality is left to complete.</li> <li>Project Task Board used to track stories (requirements) that are done, in progress, or ones that need verification.</li> </ul>                      |
| SP 1.2 | Monitor commitments against those identified in the project plan.                      | <ul> <li>Discussions on team commitments at the:         <ul> <li>Daily Scrum meeting.</li> <li>Sprint Review meeting.</li> </ul> </li> <li>Sprint Burndown chart that tracks effort remaining.</li> <li>Release Burndown chart that tracks Story Points that have been completed. This shows how much of the product functionality is left to complete.</li> </ul> |
| SP 1.6 | Periodically review the project's progress, performance, and issues.                   | <ul> <li>Daily Scrum meeting.</li> <li>Sprint Review meeting.</li> <li>Retrospectives.</li> </ul>   |
| SP 2.3 | Manage corrective actions to closure.  | <ul> <li>Tracking of actions from: <ul> <li>Daily Scrum meeting.</li> <li>Sprint Review meeting.</li> </ul> </li> <li>[Note: This assumes that teams will track (and not lose) actions.]</li> </ul>   |

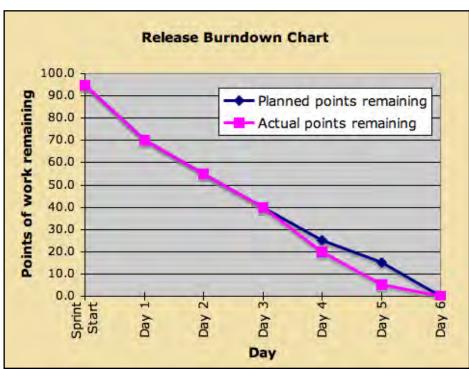
### No risk assessment / tracking in Scrum

[SP 1.3 Monitor risks against those identified in the project plan]



### **Burndown Charts**





### Implements PMC sp1.1

Monitor the actual values of the project planning parameters against the project plan.



## **Measurement and Analysis**

|        |                       | ·   |
|--------|-----------------------|---|
| SP 1.2 | Specifime as ures to  | Sprint Burndown chart that tracks effort                    |
|        | address the           | remai <b>i</b> ng.  |
|        | measurement           | <ul> <li>Release Burndown chart that tacks story</li> </ul> |
|        | objectives.           | points that have been completed. This shwors                |
|        | _                     | how much of the poduct functionality is leftto complee.     |
|        |                       | • [Note: These two measures cold be used to                 |
|        |                       | track he progress of decared project                        |
|        |                       | objectives, such as Nontime Cand Non                        |
|        |                       | budget.Ó]   |
| SD 1 1 | Specifhow             |   |
| SP 1.4 | •                     | • The Sarum process does describe the purpose               |
|        | measurement data      | and use the Sprint and ReleaseBurndown                      |
|        | will be analyzed and  | chats.  |
|        | reporte d.            | ● [Note: CMM expects clearly defined analysis].             |
| SP 2.1 | Obtain speciifed      | • Daily Sorum meeitng where Sprint and Relese               |
|        | measurement data.     | Bundown data are collected.                                 |
| SP 2.2 | Analyze and interpret | • Daily Sorummeeitng where Sprint and Relese                |
|        | measurement data.     | Burndown data are analyzed.                                 |
| SP 2.4 | Report results of     | • Daily Sorum meeitng where Sprint and Relese               |
|        | measurement and       | Burndown charts are reliewed.                               |
|        | anaysisactivites to   | • [Note: Not all interested stakeholders will               |
|        | all relevant          | necessarily be at the Scrum meeting.]                       |
|        | stakeholders.         |   |
|        |                       |   |



## How About the Other Components of Level 2?

- Configuration Management (CM):
  - CM is not specifically called out in Scrum. However, in an Agile environment it is pretty easy to add a layer of CM to protect your work.
- Product and Process Quality Assurance (PPQA):
  - Some basic PPQA activities are being done naturally when the Scrum Master checks that the Scrum process is being followed.
  - Scrum does not specifically call out a level of objective process and product check, nor does it state that particular standards or processes should be defined and used.
- Supplier Agreement Management (SAM):
  - Not included in Scrum.



### **Generic Practices?**

 Approximately half of the Level 2 GPs of REQM, PP, PMC and MA are implemented by Scrum.

| GP 2.2 | Establish and maintain the plan for performing the REQM/PP/PMC/MA process.  | The Scrum lifecycle definition and<br>the milestones to perform Scrum.  |
|--------|---|---|
| GP 2.3 | Provide adequate resources for performing the REQM/PP/PMC/MA process, developing the work products, and providing the services of the process.          | The resources and schedule time allocated to perform Scrum planning, monitoring and requirements activities.  |
| GP 2.4 | Assign responsibility and authority for performing the process, developing the work products, and providing the services of the REQM/PP/PMC/MA process. | The resource assignments allocated to perform Scrum planning, monitoring and requirements activities.   |
| GP 2.6 | Place designated work products of the REQ M/PP/PMC/MA process under appropriate levels of control.  | • [Note: Scrum does not explicitly require CM to be done. However, this can be performed using a digital camera, backed up drive, or share drive with versioning and controls turned on.] |
| GP 2.8 | Monitor and control the REQM/PP/PMC/MA process against the plan for performing the process and take appropriate corrective action.                      | Scrum Master monitoring that the steps of Scrum are followed.   |



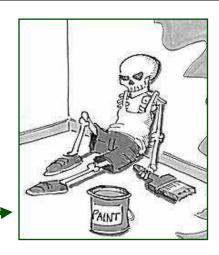
### **How About Level 3?**

- The following Level 3 components are not readily implemented by Scrum without additional work:
  - Organizational Process Focus
  - Organizational Process Definition
  - Organizational Training
  - Integrated Project Management
  - Risk Management
  - Decision Analysis and Resolution
  - Engineering PAs (e.g., RD, TS, PI, VER, VAL)
  - Generic Goal 3 (i.e., using an organization-wide and tailored process with measurements and lessons-learned)



### Scrum + -'s

- + 2-4 week cycles creates team momentum, and early feedback on progress and technical solutions.
- + Scrum process can be learned and used in less than 2 days.
- Speed can be mistaken for progress:
  - There is no "Get good requirements" phase, only "Get a list of 1-liners and prioritize." (Although some teams do more than that.)
  - There is no architecture / analysis phase, so you could implement yourself into a corner.
  - This is fixable by making the focus of each Sprint different.
- Applying Scrum to large teams and systems takes extra work.
  - e.g., System definition, integration and coordination.



90% Analysis, 10% Code 80% Analysis, 20% Code

60% Analysis, 40% Code 50% Analysis, 50% Code

0% Analysis,



## **Summary**

- Scrum is a good implementation for many of the practices in Level 2.
- A group can easily use Scrum and CMMI together.
- All the remaining practices in Levels 2 and 3 can be implemented while using Scrum.
- An organization at Level 2 or 3 could adopt Scrum as an additional lifecycle choice.



### References

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- 2. Scrum definition: http://www.scrumalliance.org/
- 3. SEI / CMU. CMMI: Guidelines for Process Integration and Product Improvement. Boston: Addison-Wesley, 2003.
- 4. Scrum and CMMI Level 5: The Magic Potion for Code Warriors, by Jeff Sutherland, Carsten Ruseng Jakobsen, and Kent Johnson. http://jeffsutherland.com/scrum/SutherlandScrumCMMIHICSS2008.pdf
- 5. Potter, N., Sakry, M., Making Process Improvement Work A Concise Action Guide for Software Managers and Practitioners, Addison-Wesley, 2002.

QuickTime™ and a decompressor are needed to see this picture.

# Practical Report: CMMI® Requirements Development (RD) and Requirements Management (REQM) Process Areas in an Agile Environment

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Please send to the authors if you are interested in reading the full paper pertained to this presentation



## Feasibility of Agile and CMMI

- "The two methods are certainly compatible" Mike Konrad, Senior Member of Technical Staff Software Engineering Process Management **Program**
- "It was an opportunity for us at SEI to dispel some myths and 'apologize', in a sense, to some people in the Agile community" Mike Konrad
- Why Not Embrace Both technical report by SEI
- Jeff Sutherland Recommends Combining Scrum with CMMI Level 5 Jeff Sutherland is one of scrum inventors
- And Others ... (www)

## Feasibility of Agile and CMMI (Cont'd)

Our Own Various
 Implementations verify the feasibility!

# (Cont'd) They are Synthetically welded?



Permission of image copy is down this slide

# (Cont'd) But, they are



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## Why Agile CMMI?

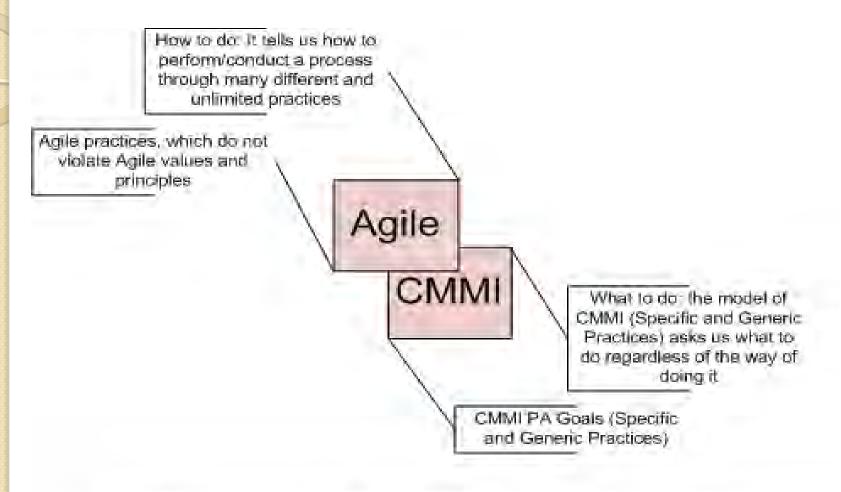
- Easily understanding of model intent,
- Thinking in terms of valuable compliance instead of just compliance or filling contract requirement,
- Paying more attention to people,
- Manage the fast deliverables.

- Flow of Requirements is a value-driven to the client
- Simple Example: Conference Website
  - Elements: About us, Contact us, Status of Papers, Call for Papers, Registration, and Facilities

About Us and Contact Us \$

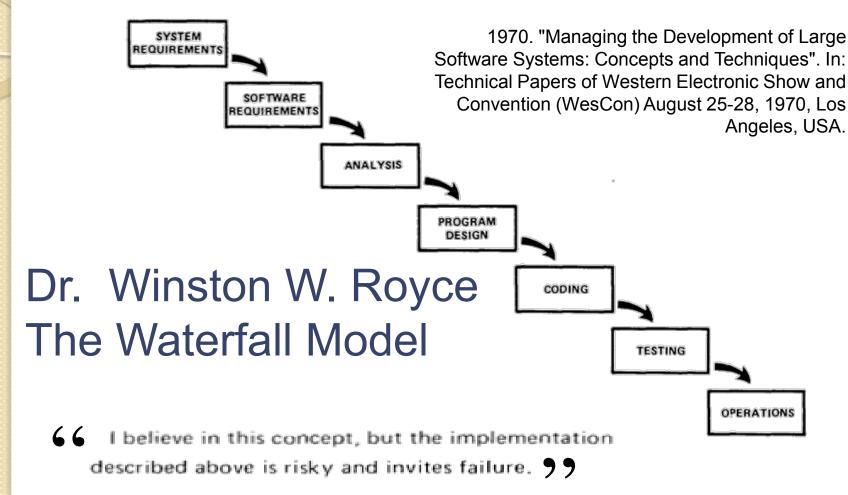
Registration and Call for Papers \$\$

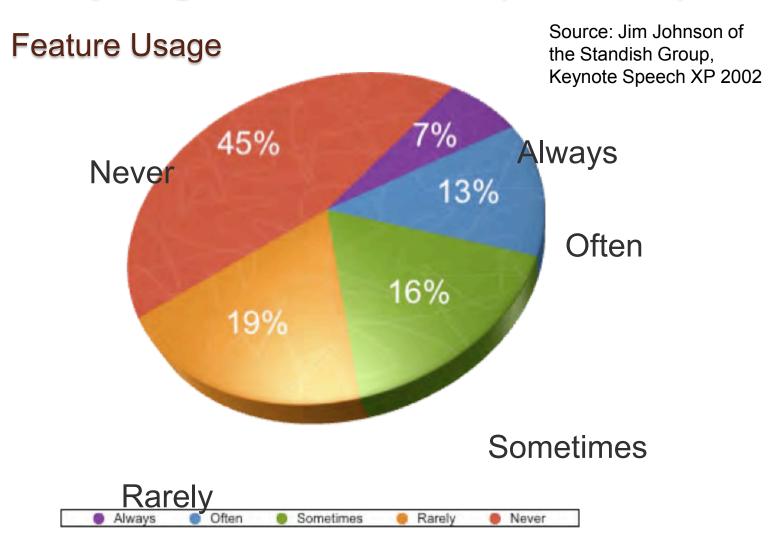
Status of Papers and Facilities



Brief Relationship between Agile and CMMI from Implementation perspective

- Heavy-weight processes lead to:
  - a late delivery,
  - an inaccurate assurance of quality,
  - a misleading to the required value,
  - a more budget,
  - a lot of work around by stakeholders to survive!
- Remember, there are some competitors over there!





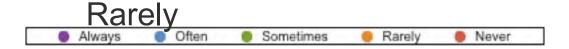


Source: Jim Johnson of the Standish Group, Keynote Speech XP 2002



- We need to focus more of prioritizing features and delivering value quicker than focusing on implementing all the features
- •We need to focus on the ROI of each feature for your customer with the help of customer
- •We need to focus on the ROI of each feature as a product manager

### Sometimes



Dr. Sidk,y: Introduction to Agile

**Challenged Projects** 

USA: \$80-145 billion per year is spent on failed and cancelled projects

UK :12 out of 18 Large IT projects have failed



Standish Report - 2006

Dr. Sidky: Introduction to Agile



### However,...

### Market value of publicly traded shares:

\$NA (31 December 2009 est.) country comparison for the world \$34.95 trillion (31 December 2008)

\$64.56 trillion (31 December 2007 est.)

#### Industries:

dominated by the onrush of technology, especially in computers, robotics, telecommunications, and medicines and medical equipment; most of these advances take place in OECD nations; only a small portion of non-OECD countries have succeeded in rapidly adjusting to these technological forces; the accelerated development of new industrial (and agricultural) technology is complicating already grim environmental problem

### Industrial production growth rate:

CIA World Factbook - 2010

Dr. Sidky: Introduction to Agile



### However,...

### Market value of publicly traded shares:

\$NA (31 December 2009 est.)
country comparison for the world

- •What if we increased our IT profits to both vendor and client?
- •What if we eliminated (or decreased) the challenged, failed and canceled projects?

dominated by the onrush of technology, especially in computers, robotics, telecommunications, and medicines and medical equipment; most of these advances take place in OECD nations; only a small portion of non-OECD countries have succeeded in rapidly adjusting to these technological forces; the accelerated development of new industrial (and agricultural) technology is complicating already grim environmental problem

#### Industrial production growth rate:

CIA World Factbook- 2010

Dr. Sidky: Introduction to Agile

## What is "Agile CMMI Practice" or ACP?

- Agile Practice is not only Scurm or XP practice!
- Agile CMMI Practice (ACP) is the practice (or way of doing an activity) that achieves the Specific Practice (SP) in CMMI Model if and only if this practice achieves at least one of Agile Values and Principles without violating any of them.

## In 7 Steps, how do you achieve

- Make sure of your senior management adoption,
- Discuss the policy and process improvement project vision by reaching consensus with all stakeholders about the vision and goals of this project,
- Specify the process areas in scope (i.e. what?), 3.
- Meet the users (actual implementers) of each practice in the selected process areas,
- Explore ,with the implementers, all possible valuable ways of doing these practices which do not violate any of Agile Values and Principles,
- Consolidate the output from users to reach the way of implementing the selected process areas and implicitly its practices (i.e. how?)
- Inspect and adapt (i.e. process improvement cycle is always active)
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# Difference Between "Convey" and "Preserve" Information

|       | "Convey" Information   | "Preserve" Information  |
|-------|--|---|
| Why?  | Transfer information within your team members for alignment and having the same understanding of this information.   | Store information for further references, reviews, reuses and organization history.   |
| How?  | It depends on the case you have, that's why Agile is human-centric, you choose the best way for conveying information in your case. And do not forget that one of Agile principles is "the most efficient and effective method of conveying information to and within a development team is face-to-face conversation", however, if there are rigid constraints in achieving this way, move to the next communication way which invites interaction within team members. This encourages you to achieve the first step of SAMI (Sidky Agile Measurement Index), it is a 5-step value-based roadmap to agility and designed to help guide organizations seeking to become more agile. Each of SAMI's 5 steps (Collaborative, Evolutionary, Integrated, Adaptive and Encompassing) aims to instill a new value in teams and organizations. | Also, it depends on the case. Usually, people prefer using different types of documentations project management tools, document management systems and we prefer using a system that supports your files' configurations such as version history details. |
| When? | In every time the team members communicate any information regarding the project   | In all legal and formal communications. And when you want to ensure commitment and understanding of any information or responsibilities with either the customer or project team members.   |

### Assumption

The remaining part of this presentation mainly assumes that:

- you know and understand Agile scrum and XP practices,
- you understand REQM and RD Specific Practices,
- a project/task management tool is (or will be) used in your organization,
- you perform User Acceptance Testing (UAT) at the end of your release,
- if you do not apply Test Automation or Test Driven Development (TDD), there is a release stabilization to perform system and regression testing,
- user story, beside its being a valuable feature to the customer, it can be a non-functional requirement,
- and all requirements are represented in user stories.

#### Requirements Development - RD

<u>(</u>1/3)

The purpose of Requirements Development (RD) is to produce and analyze customer, product, and product component requirements.

| - |     |   |  |  |  |
|---|-----|---|--|--|--|
|   | SP# | CMMI Specific Practice                        | Agile CMMI Practice (ACP)  |  |  |
|   | 1.1 | Elicit stakeholder needs, expectations,       | All customer meetings for gathering requirements:                                      |  |  |
| 1 |     | constraints, and interfaces for all phases of | Gathering of High level stories, External  |  |  |
|   |     | the product lifecycle.                        | Chartering (sometimes called "Customer/project   |  |  |
|   |     |   | Kickoff"), Scope of Work, Release and Iteration  |  |  |
| E |     |   | stories.   |  |  |
|   |     |   | External Chartering: or customer/project kickoff is                                    |  |  |
|   |     |   | to make both service provider and customer aligned with the same vision, goals and its |  |  |
|   |     |   | 1  |  |  |
|   |     |   | measure of success, project plan, stakeholder's roles and responsibilities.            |  |  |
|   | 1.2 | Transform stakeholder needs,                  | All customer meetings for gathering the  |  |  |
|   | 1.2 | expectations, constraints, and interfaces     | requirements: Gathering of High level stories,   |  |  |
|   |     | into customer requirements.                   | External Chartering (sometimes called  |  |  |
|   |     |   | "Customer/project Kickoff"), Scope of Work,  |  |  |
|   |     |   | Release and Iteration (or Sprint) stories  |  |  |
|   | 2.1 | Establish and maintain product and product    | Scope of Work, Release and Iteration stories   |  |  |
|   |     | component requirements, which are based       |  |  |  |
|   |     | on the customer requirements.                 |  |  |  |
|   | 2.2 | Allocate the requirements for each product    | Release/Iteration Planning and Stories; by   |  |  |
|   |     | component.                                    | grouping the related stories for each product component.                               |  |  |
|   |     |   | I  |  |  |

#### Requirements Development - RD

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| М. |     |  |   |  |  |
|----|-----|--|---|--|--|
| Ä  | SP# | CMMI Specific Practice   | Agile CMMI Practice (ACP)   |  |  |
| // | 2.3 | Interfaces between functions (or between objects) are identified.      | Project release stories.  |  |  |
|    | 3.1 | Establish and maintain operational concepts and associated scenarios.  | Project team discusses the user stories and its business acceptance tests (sometimes called "Business Acceptance Criteria") with the business analyst and/or the customer directly (if business analyst only, the business analyst has to discuss and confirm these user stories and acceptance tests).   |  |  |
|    | 3.2 | Establish and maintain a definition of required functionality.         | After reaching consensus and alignment with the customer regarding the user stories (project features and non-functional requirements), communicate them to the team, and preserve them in a maintainable documentation.  |  |  |
|    | 3.3 | Analyze requirements to ensure that they are necessary and sufficient. | Each user story includes business acceptance tests which are subjected to testing during the iteration, the comments of your customer in iteration demo if possible, and UAT feedback. These check-points of requirements' sufficiency, significantly, decrease the uncertainty of the target value to the customer (i.e. reaching what the customer needs more than what the customer "wants"). From high level view: the kickoff meetings that include the main goals of the project support this practice. |  |  |

#### Medallellie Develobillelli – MD

(3/3)

| ж, |     |   |   |
|----|-----|---|---|
|    | SP# | CMMI Specific Practice  | Agile CMMI Practice (ACP)   |
|    | 3.4 | Analyze requirements to balance stakeholder needs and constraints.  | Each user story includes business acceptance tests which are subjected to testing during the iteration, the comments of your customer in iteration demo if possible, and UAT feedback. Meeting the stakeholders in kickoffs, demos, planning and status review meetings help you balance the needs and constraints.   |
|    | 3.5 | Validate requirements to ensure the resulting product will perform as intended in the user's environment. | Each user story includes business acceptance tests which are subjected to testing during the iteration, the comments of your customer in iteration demo if possible, and UAT feedback. Meeting the stakeholders in kickoffs, demos, planning and status review meetings help you validate your customer requirements (i.e. make sure that the requirements you are developing are your actual customer needs, and accordingly, the project meets your customer expectation. One of the four agile values [2] is "Customer Collaboration over Contract Negotiation" which means collaboration in understanding the requirements as well. |
|    |     |   | <u></u>   |

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22 - NDIA - National Defense and Industrial

### (1/3)

| ж. |     |  |  |
|----|-----|--|--|
|    | SP# | CMMI Specific Practice   | Agile CMMI Practice (ACP)  |
|    | 1.1 | Develop an understanding with the requirements providers on the meaning of the requirements. | All planning meetings (Project, Release, Iteration and even daily standup meetings), and we prefer that the business analyst role (or customer representative) should be involved in such meetings at least on iteration level; this ensures that the team members have the same understanding of requirements as the customer does.  Moreover, iteration demos are key practice for understanding customer requirements.  |
|    | 1.2 | Obtain commitment to the requirements from the project participants.                         | We encourage agile practitioners to pay more attention to this practice. And as we used to say, do your way of taking commitment from both customer and project team members but make sure that this way is effective when the situation goes to any kind of conflict. One of the ways is using formal emails or even audio/video recording with your customer, and for project team members the way should be more smooth such as project/task management tool, standup meetings, iteration plansetc. |

| •   | . to quit office it and gottion to the airi                                   |   |  |
|-----|---|---|--|
| 12  | /3)   |   |  |
| SP# | CMMI Specific Practice  | Agile CMMI Practice (ACP)   |  |
| 1.3 | Manage changes to the requirements as they evolve during the project.         | In your project/task management tools, differentiate between the first (original) requirements and other further changes even by labeling them. Try to make the view easy to be tracked (i.e. building a reportable system; for example, in anytime after one year of production in a project, you can know what the changes are, their status, their relationships with each other and with the first requirements)  |  |
| 1.4 | Maintain bidirectional traceability among the requirements and work products. | Without this practice, most probably you will fail in managing your software projects especially medium/ large projects. Your requirements should be in one body with all other elements (test cases, architecture, tasksetc), and make sure that user stories, architecture, business acceptance tests, test cases, technical tasks, bugs, and project plans are all traceable and connected. An easy way to do that is using any agile project/task management tool (there are a lot of open source and commercial products that will serve you). |  |

Requirements Management - REQIM

## (3/3)

|   | SP# | CMMI Specific Practice                             | Agile CMMI Practice (ACP)                   |
|---|-----|--|---|
| 1 | 1.5 | Identify inconsistencies between the project plans | In one body of requirements, you can easily |
|   |     | and work products and the requirements.            | identify the inconsistencies (usually, a    |
|   |     |  | tracking tool is used)                      |

# Requirements Traceability Body in Agile (RTBA)

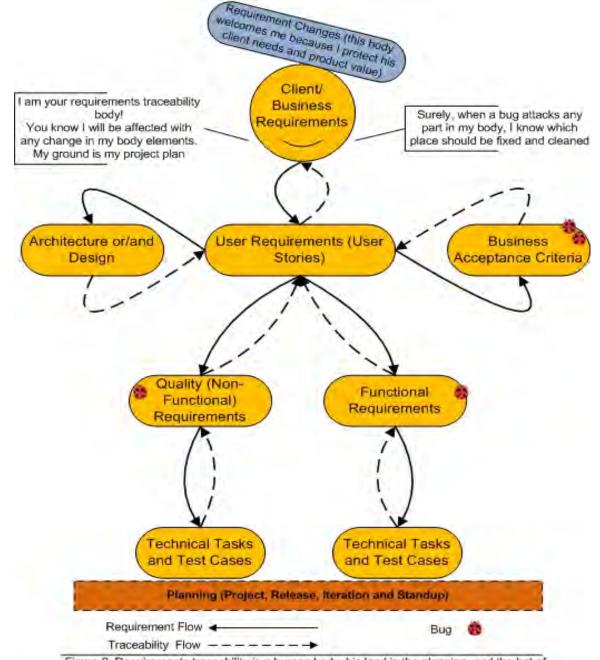


Figure 2: Requirements traceability is a human body, his land is the planning, and the hat of changes come to protect the body from the deviation in his way to make his product more valuable to his client

### Important! Conclusion

It is not only possible to embrace both agile and CMMI, but also it is **easier and proven practically**. The presentation is not supposed to show the best practices for your organization, the fore mentioned practices may not work in your organization.

However, **inspect and adapt** to reach the most appropriate practice that adds the **best possible value** to your organization **and** your customer. Also, because agile mindset supports CMMI model intent, we found a light-weight implementation that we cannot work without.

# Thank You! Further Questions?

### The Perils of 'Agile, But'



**Dottie Acton LM Senior Fellow** 

dottie.acton@lmco.com

#### **Topics**



- Foundations of Agile
- Some Statistics
- Some 'Agile, but' examples
- Recommendations

#### The Foundations of Agile

Clear

**Product** 

Vision



**Product Backlog** 

**User Stories** 

Continuous **Planning** 

> Iteration **Planning**

Co-located **Teams** 

Visible

**Progress Indicators** 

**Continuous** 

**Short Delivery** 

Cycles

**Daily Standup** Meeting

Integration **Development** (TDD)

**Stakeholder** 

Value

**Technical** 

Excellence

**Test-Driven** 

**Active Stakeholder Participation** 

> **Potentially Shippable** Software

> > Refactoring

Adherence to **Standards** 

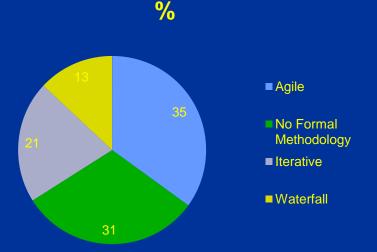
**Pair Programming** 

Retrospectives

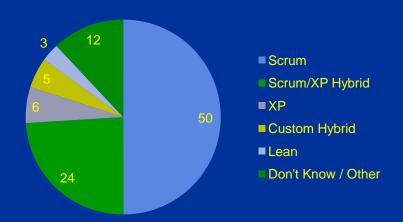
**Lockheed Martin Copyright 2010** 

#### The State of the Agile World





Based on a 2009 Forrester / Dr Dobbs survey, Agile adoption is real.



%

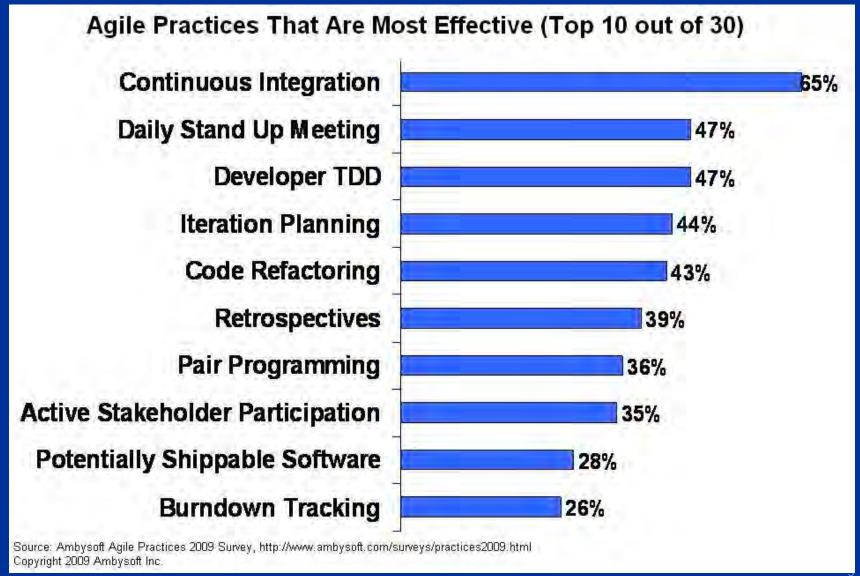
Based on the Version One 2009 Survey, Scrum and Scrum/XP hybrid are the most popular approaches.

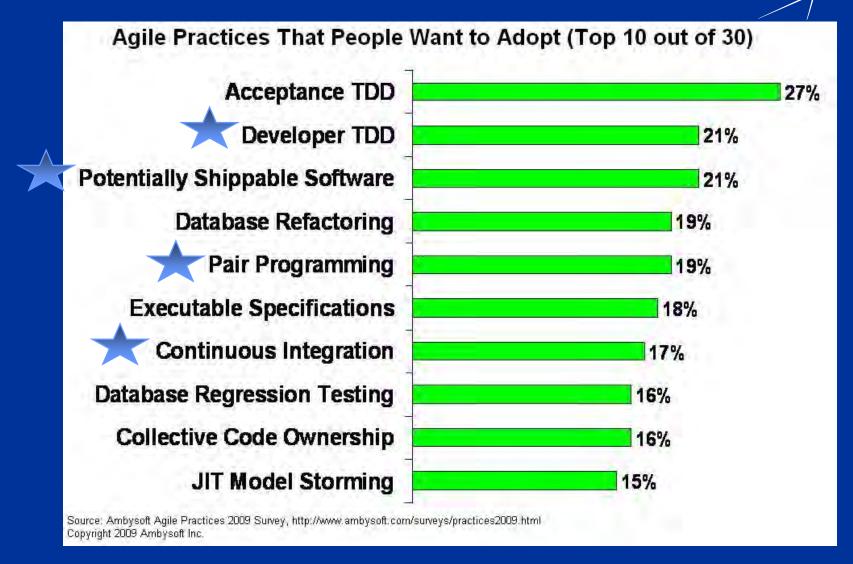


Agile and CMMI are no longer at war with each other.

#### A Closer Look



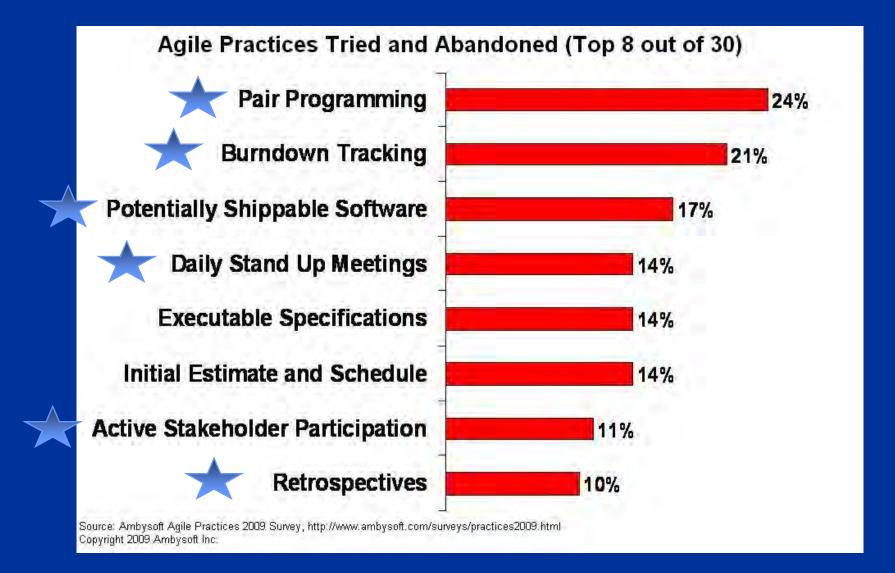




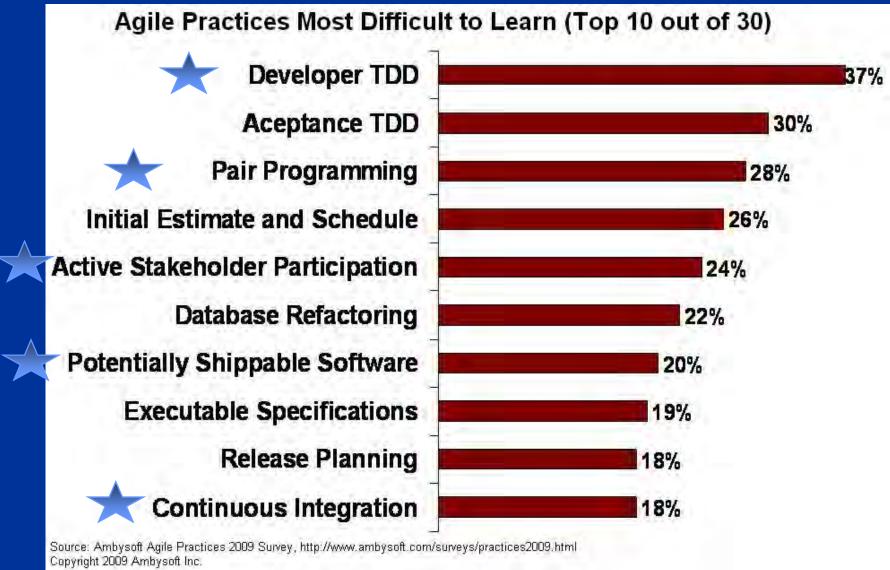


= one of the top 10 effective practices









#### **Therefore**



- There must be a lot of projects that are 'Agile, but' are not using all of the practices known to be effective.
  - So, how do we assess the risk for those projects that claim to be 'Agile, but' are not using some of the practices known to be effective?

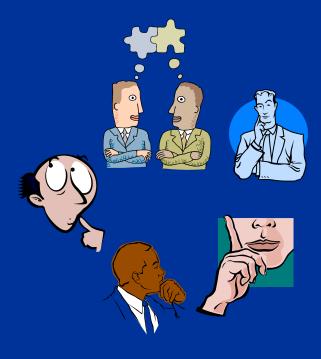
#### **Premise:**



- Let's use CMMI as a cross-check for risk.
  - The lower CMMI level, the greater the risk.
  - Failing to satisfy goals implies more risk than failing to satisfy particular practices.
- When goals will not be met, alternative practices will be needed.
  - Hybrid approaches may be more appropriate than 'Agile, but'.







Retrospectives

- What does CMMI say?
  - CAR SG 1 Determine causes of defects.
  - CAR SG 2 Address causes of defects.



 Without retrospectives, problems other than those identified via discrepancy reports may not be identified or addressed systematically.

# We're 'Agile, but' we don't have active stakeholder participation.



- Stakeholder participation is needed for release planning, iteration planning and demonstrations.
- Stakeholders also need to be available to answer questions and clarify requirements.

- What does CMMI say?
  - REQM SG 1 Manage requirements.
  - PP SG 3 Obtain commitment to the plan.
  - IPM SG 2 Coordinate and collaborate with relevant stakeholders.
  - RD SG 1 Develop customer requirements.
  - RD SG 2 Develop product requirements.
  - RD SG 2 Analyze and validate requirements.



We need to ask what the team is doing for requirements management and analysis.

# We're doing 'XP, but' we aren't doing pair programming.



Pair programming gives 2 sets of eyes on the code at all times.

- What does CMMI say?
  - VER SG 2 Perform Peer Reviews



- Agile teams that do not do pair programming need some other form of peer review.
  - Reviewing every week at a specific time.
  - Reviewing at the end of the iteration.
  - Using static analysis tools and test coverage tools to supplement human reviews.

# We're 'Agile, but' we aren't doing continuous integration.



- What does CMMI say?
  - PI SG 1 Prepare for product integration.
  - PI SG 2 Ensure interface compatibility.
  - PI SG3 Assemble product components and deliver the product.

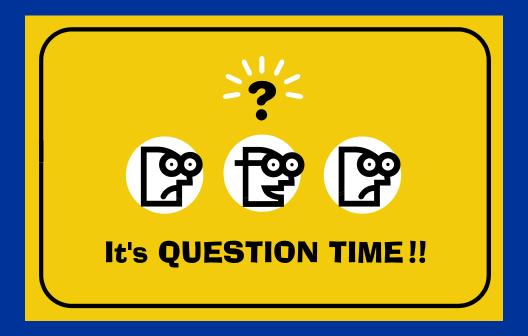


#### Recommendations



- When you hear we're 'Agile, but', check what the CMMI has to say
  - Is a goal being missed?
  - Will alternative practices work?
  - Is it an OK modification?
    - E.g. virtually co-located teams are OK when supported by a communications infrastructure

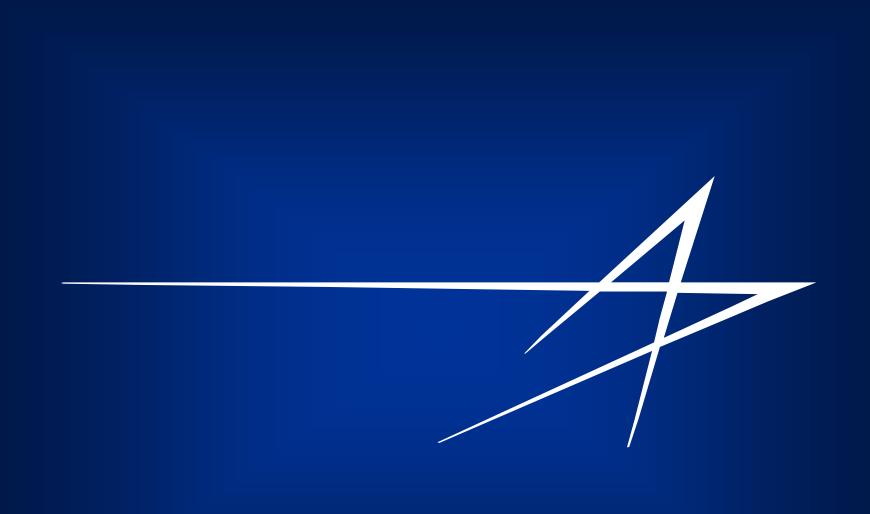




#### References



- CMMI or Agile: Why Not Embrace Both? SEI Technical Note, Nov 2008
- Implementing Scrum (Agile) and CMMI Together by Neil Potter and Mary Sakry, Mar 2009
- Love and Marriage: CMMI and Agile Need Each Other by Hillel Glazer, Crosstalk, Jan/Feb 2010



## Tips and Hints for CMMI V1.3

Software Engineering Institute Carnegie Mellon University Pittsburgh, PA 15213

Mary Beth Chrissis, Mike Konrad, Sandy Shrum November 17, 2010

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#### **Purpose**

The purpose of this presentation is to discuss the changes in CMMI V1.3 in the context of how you interpret and apply those changes.

You may ask, "Now that the CMMI Product Suite was released, how do I use it?" By the end of this presentation, I hope that you have some tips and hints that you can apply on your CMMI V1.3 journey.

Caveat: There are many different ways to interpret and apply this material.

One of the true advantages of using CMMI is the ability to use this material in many different contexts and situations. Therefore, only use this information if you agree with it.

- If it doesn't fit your organization understand why.
- Understand what you do differently.
- Adjust this guidance to fit your needs.



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#### **Topics**

CMMI Model(s) Changes

CMMI-DEV Addison-Wesley Book

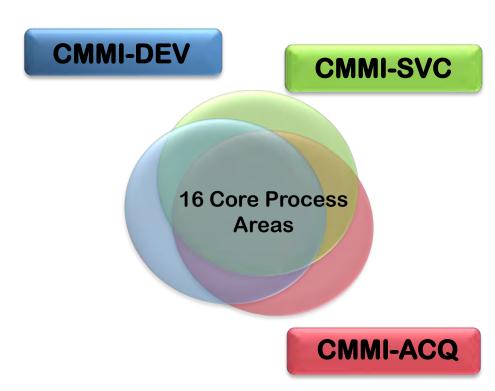
#### CMMI V1.3 Model(s) Changes

### Three Constellations and Three Models: Which Do I Choose?

Because of harmonization, the models are more similar in V1.3.

Core PAs appear in all CMMI models; however...

- These PAs are not identical across all models.
- Informative material can be different so that users interpret goals and practices for their area of interest.
- Sometimes practices can be different in one model from another (i.e., PP, PMC).



Pick the model that most closely aligns with your business needs.

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#### Picking the Right Model for Your Organization<sub>1</sub>

If you are just starting process improvement (i.e., working for two years or less),

- pick one of the models and use it,
- focus on the core process areas, and
- remember that some of the core process areas are slightly different (e.g., PP and PMC at the specific practice level, names of the PAs).

If you are a seasoned CMMI user,

- use all 3 models, especially if you are improving many different parts of your organization, and
- look at the "unique" PAs.

If you have been using only CMMI-DEV, you are missing out on useful practices.



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## Picking the Right Model for Your Organization<sub>2</sub>

The V1.2 models were improved and released incrementally.

CMMI-DEV was released in 2006.

CMMI-ACQ was released in 2007.

Two years later, CMMI-SVC was released.



CMMI-DEV is where the most change occurred from V1.2 to V1.3.

In many instances, changes to CMMI-DEV for V1.3 were already incorporated into the other two models as part of their development efforts for V1.2.

As you would expect, CMMI-SVC has the least change.

### **Understanding the Changes**

If you are a seasoned CMMI user, you will find the comparison files useful. They are available at http://www.sei.cmu.edu/cmmi/tools/cmmiv1-3/index.cfm

All model changes are included in the comparison files:

- Movement of material
- Editorial changes
- Harmonization changes

Comparison files do not help you find the major changes, however. The CMMI V1.3 Model Upgrade Training is a better source for understanding high-level changes.

Also, many of the presentations at this conference address changes to V1.3 and are good sources of information.

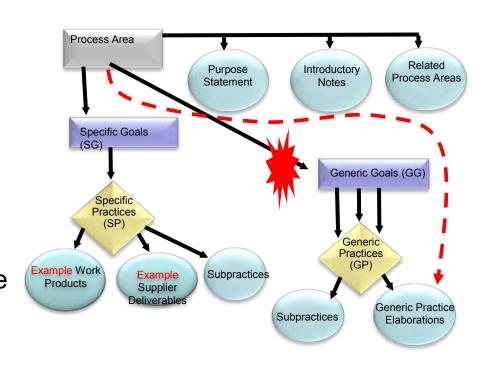
### **Architecture Changes**

Most components did not change.

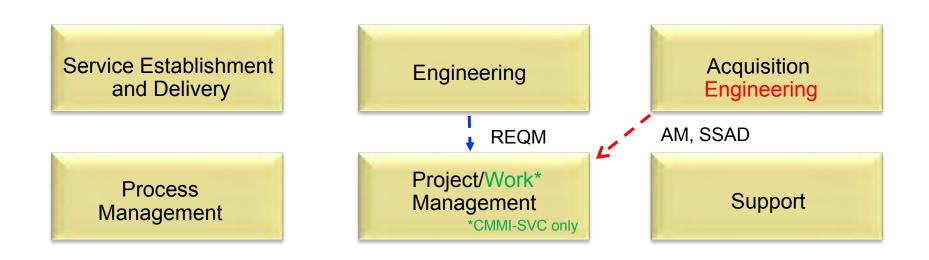
One primary change was that "typical" was replaced by "example" when presenting work products.

The result should be that this component is easier to interpret and more usable.

Your organization is more likely to be successful in developing the work products that are right for your organization instead of those presented in CMMI.



## **Changes to PA Categories**



These changes should provide a more natural fit to align with PA content.

If you have tools or documents that use PA categories, slight adjustments will be needed.

## Changes to Generic Goals and Practices₁

In CMMI-DEV, the location of generic goals (GGs) and generic practices (GPs) was changed.

- Don't let this change minimize the importance of the GGs and GPs.
- Use this change as an enabler to stress the importance of establishing the "process improvement" infrastructure in your organization.
- If you have different teams interpreting and applying PAs, don't let them forget to look at the GGs and GPs, especially the elaborations.
  - Remember that elaborations only exist in CMMI-DEV and CMMI-SVC.

# Changes to Generic Goals and Practices,

| Generic Goals                              | Generic Practices  |
|--|--|
| GG1: Achieve<br>Specific Goals             | GP 1.1: Perform Specific Practices   |
| GG2: Institutionalize a<br>Managed Process | GP 2.1: Establish an Organizational Policy GP 2.2: Plan the Process GP 2.3: Provide Resources GP 2.4: Assign Responsibility GP 2.5: Train People GP 2.6: Control Work Products GP 2.7: Identify and Involve Relevant Stakeholders GP 2.8: Monitor and Control the Process GP 2.9: Objectively Evaluate Adherence GP 2.10: Review Status with Higher Level Management |
| GG3: Institutionalize a Defined Process    | GP 3.1: Establish a Defined Process GP 3.2: Collect Improvement Information  |

Adapted from Cepeda Systems & Software Analysis, Inc.

These changes were always implied but now they are explicitly stated.



# Changes to Generic Goals and Practices<sub>3</sub>

The biggest change – level 4 and 5 generic goals and practices were eliminated to appropriately focus high maturity on the achievement of business objectives.

Thus, the concept of capability levels 4 and 5 was removed also.

- **GG 4 Institutionalize a Quantitatively Managed Process**
- **GP 4.1 Establish Quantitative Objectives for the Process**
- **GP 4.2 Stabilize Subprocess Performance**
- **GG 5 Institutionalize an Optimizing Process**
- **GP 5.1 Ensure Continuous Process Improvement**
- **GP 5.2 Correct Root Causes of Problems**

### What Happened to IPPD and Amplifications?

Fewer than 5% of recent appraisals have included IPPD. However, in today's environment most people work in teams.

Teaming has been embedded consistently in all 3 models.

- This change allows you to address these concepts as intended.
- You don't have to worry about whether to include teaming practices or not.

In CMMI-DEV there were about 20 amplifications for SE, SW, and HW and none in CMMI-ACQ or CMMI-SVC. Therefore, amplifications were removed. Useful amplifications were converted to examples and notes.

- The concept of amplification was often confusing.
- This change should allow CMMI users to look at this information like other informative material.

### Terminology Was Improved<sub>1</sub>

CMMI terminology evolved and wasn't always consistent with the release of new constellations.

The model component descriptions were revised. If defined in the glossary the following occurred:

- The redundant text in the description was minimized.
- Inconsistent text was eliminated.
- A reference to the glossary was added.

Some glossary terms were not consistent with how the same terms were described in other parts of the model and they did not accurately reflect their relationships with other terms.

The glossary had a "good scrub."

Therefore, when you don't understand a term, first refer to the glossary.

## **Terminology Was Improved<sub>2</sub>**

Certain words and phrases that appear in goal and practice statements unnecessarily complicate their interpretation.

Words and phrases that were considered problematic include: appropriate, best, designated, effectively, essential, most important, necessary, realistic, reasonable, and relevant.

When implementing these practices, it should be a given that you implement what is "appropriate" for the project and organization.

This change should minimize some of the interpretation wars that occurred during appraisals.



### **Informative Material**

Informative material was improved, including revision of the Engineering practices to reflect industry best practice and additional guidance for organizations that use Agile methods.

References were revised so that users can easily find the information that the reference points to by searching for a goal or practice title or purpose statement in the destination PA

A standard sequence of references was introduced when there are multiple adjacent references:

- Constellation-unique PAs appear first.
- Within each PA reference grouping, the references are listed alphabetically by the destination PA.



### **Front Matter Changes**

The history of CMMI was added to accompany Figure 1.2.

With a few exceptions, the mention of "source models" was removed.

Biases favoring maturity levels or capability levels were removed.

Clarifications were added that CMMI models are not processes or process descriptions.

Information was added about selecting the right CMMI model.

Clarifications were added that Chapter 2, Process Area Components, contains descriptions, not definitions.

In DEV only, it is now mentioned that recursion among PAs can also apply to Project Management PAs. (In V1.2, some inferred the idea of recursion might apply to Engineering PAs only.)

Changes were made to explicitly state what was always implied.



## PA Changes at Maturity Levels 2 and 3

All PAs have changed.

Five PAs were changed at the goal level:

IPM, IRP, OPD, OT, and RD

Fourteen PAs were changed at the specific practice level:



- SSAD
- PI, RD
- IRP, SCON, SSD, SST, STSM

Be sure to plan adjustments to your process improvement efforts. And don't forget to mine the changes to the informative material to determine how those changes may benefit your organization.



## High Maturity Changes₁

High maturity concepts and terminology were confusing in V1.2.

High maturity requirements were implied, not explicitly stated and were sometimes contained in documents other than the model.

Explanations were not central or consistent.

There were inaccurate perceptions about high maturity.

High maturity concepts were present in ALL constellations, but in much of the material examples focused on development.

If you are a high maturity organization or are pursuing high maturity, move to V1.3 as quickly as possible!

# **High Maturity Changes**<sub>2</sub>

High maturity process areas are significantly improved to reflect industry best practices, including a new specific goal and several new specific practices in the process area that was renamed from Organizational Innovation and Deployment (OID) to Organizational Performance Management (OPM).

Organizational Process Performance was reordered.

Quantitative Project Management was reordered and modified.

The scope of Causal Analysis and Resolution was changed.

- "Defects and other problems" was replaced by "outcomes," which can be successes as well as deficiencies.
- The emphasis on "proactive" defect prevention was increased.

# CMMI-DEV Addison-Wesley Book

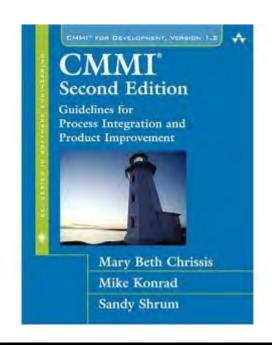
10th Annual CMMI Technology Conference

### The Book Changes

The design of the Addison-Wesley book stayed basically the same as the second edition (Version 1.2).

- Some perspectives stayed the same, some were updated, and new ones were added.
- The case study was replaced with three shorter case studies.
- Tips and hints were only modified where needed. The Engineering and high maturity PAs had the most change.

The book is scheduled for release at SEPG North America, March 21-24, 2011.



### **Summary**

The V1.3 changes are improvements to the model.

The model should be easier to implement and interpret if you have been following sound process improvement principles.

These changes should not have a noticeable effect on what you have been doing.

They should be more of a *natural* fit.

Does it surprise you that most of the change occurred in the informative material?



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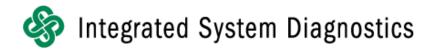
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**World Wide Web:** 

http://www.sei.cmu.edu/productlines

SEI Fax: 412-268-5758





U.S. Army Research, Development and Engineering Command



### TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

### CMMI-DEV v1.3 Good? – Bad? – Ugly?

Jackie Lawrence Certified High Maturity SCAMPI Lead Appraiser
Nathaniel Becker US Army Armament SEC Process Lead
Jeanine Courtney-Clark Certified High Maturity SCAMPI Lead Appraiser







### Context

- Appraisal Preparation and Planning
- Appraisal On-site
- Appraisal Reporting

Impact on Appraisal Results

**CMMI®- DEV v1.3 Practice Characterizations** 

**Model Specific Recommendations** 

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## Organizational Context



- Long (>10 year) organizational process improvement legacy.
- Appraisal Sponsor requested the appraisal team pilot CMMI®- DEV v1.3 high maturity practices.
- Appraisal objective determine the potential impact to the organization's current practices.
- Repeat CMMI® ML 5 appraisal for the organization.





# Appraisal Preparation and Planning Considerations



### Appraisal team training supplemented by:

- Most of appraisal team attended the SEPG 2010 Conference special session: CMMI<sup>®</sup>- DEV v1.3 for High Maturity Lead Appraisers, as invited guests.
- QPM and OPM webinar conducted by two members of the SEI staff and other CMMI®- DEV v1.3 development team members during the appraisal readiness review.
- Each team member was required to review the CMMI®- DEV v1.3
   GLOP provided to the team by the SEI CMMI® Program Manager.

### Other Planning

- No additional interviews.
- No additional data collected.
- No schedule impact.







| Jackie Lawrence (Team Lead) | ISD                 |
|-----------------------------|---------------------|
| Nathan Becker               | Armament SEC        |
| Billy Thomas                | Armament SEC        |
| Helen Huie                  | Armament SEC        |
| Steve Lubash                | Armament SEC (UTRS) |
| Timothy Grealy              | QESA                |
| Jeanine Courtney-Clark      | ISD                 |





## DRAFT Model Materials Used



### CMMI®- DEV v1.3 materials used.

- GLOP March 22, 2010 (CAR and OPP)
- QPM April 28, 2010 (email date)
- OID/OPM May 12, 2010





### Team Approach



- Use the existing data provided by the organization for the CMMI-DEV v1.2 appraisal.
- Focus on ML4 (OPP and QPM) and ML 5 (OPM and CAR) process areas.
- Identify areas that may impact either implementation or an appraisal.
- Carefully review the intent of the new model text and classify each change as either better explanations, new expectations (practice changes) or new recommendations (informative text).



# Organizational Process Performance - OPP



### **Team Feedback/Experience:**

"Maintain Business Objectives" (OPM SP 1.1) seemed out of sequence. We felt a need to have a practice in OPP to maintain objectives already established (also see recommendation for OPF).

The explanations in the informative material are more helpful. Specifically the new language in sub practices 1 – 3:

- criteria for selecting sub practices,
- traceability between sub processes and objectives
- using causal and sensitivity analysis for sub process selection
- determining a range of expected performance results.

### **Team Recommendation:**

Move SP 1.1 Maintain Business Objectives from OPM SP 1.1 to OPP SP 1.1 and renumber practices in OPP SG 1.





# OPP v1.3 vs v1.2 Change Highlights



- v1.3 New SP 1.1 Establish and maintain the organization's quantitative objectives for quality and process performance, which are traceable to business objectives.
- v1.3 SP 1.2 Select processes or subprocesses in the organization's set of standard processes to be included in the organization's process performance analyses and maintain traceability to business objectives.
- v1.3 SP 1.3 Establish and maintain definitions of measures to be included in the organization's process performance analyses.
- v1.2 SP 1.3 Establish and maintain quantitative objectives for quality and process performance for the organization.
- v1.3 SP 1.4 Analyze the performance of the selected processes, and establish and maintain the process performance baselines.
  - 1.2 SP 1.4 Establish and maintain the organization's process-performance assistings.



### RDECOM Quantitative Project Management



### **Team Feedback/Experience:**

There appears to be significant overlap between QPM SP 2.1 and QPM SP 2.2 (e.g., a clear distinction is not made between manage versus monitor in the subpractices). [QPM SP 2.1, QPM SP 2.2]

We would prefer to see some other types of examples. As written this the model may lead organizations to focus on PR too much. [QPM SP 1.2]

We suggest there should be fewer subpractices on measures and more on selecting analytic techniques. [QPM SP 1.4]

QPM SP 2.2 subpractice 6 and QPM SP 2.3 subpractice 2 are virtually the same. [QPM SP 2.2, QPM SP 2.3]

### **Team Recommendation:**

**Smove SP 2.2 Monitor Performance of the selected sub processes.** 



# QPM - v1.3 vs v1.2 Change Highlights



# v1.3 SP 1.2 Using statistical and other quantitative techniques, compose a defined process that enables the project to achieve its quality and process performance objectives.

v1.2 SP 1.2 Select the subprocesses that compose the project's defined process based on historical stability and capability data.

# v1.3 SP 1.3 Select subprocesses and attributes critical to evaluating performance and that help to achieve the project's quality and process performance objectives.

v1.2 SP 1.3 Select the subprocesses of the project's defined process that will be statistically managed.

# V 1.3 SP 1.4 Select measures and analytic techniques to be used in quantitative management.

v1.2 SP 1.4 Monitor the project to determine whether the project's objectives for quality and process performance will be satisfied, and identify corrective action as appropriate.





# QPM - v1.3 vs v1.2 Change Highlights



# SP 2.1 Monitor the performance of selected subprocesses using statistical and other quantitative techniques.

v1.2 SP 2.1 Select the measures and analytic techniques to be used in statistically managing the selected subprocesses.

SP 2.2 Manage the project using statistical and other quantitative techniques to determine whether or not the project's objectives for quality and process performance are being satisfied.

v1.2 SP 2.2 Establish and maintain an understanding of the variation of the selected subprocesses using the selected measures and analytic techniques.

SP 2.3 Perform root cause analysis of selected issues to address deficiencies in achieving the project's quality and process performance objectives.

v1.2 SP 2.3 Monitor the performance of the selected subprocesses to determine their capability to satisfy their quality and process performance objectives, and identify corrective action as necessary.





## Causal Analysis and Resolution



### **Team Feedback/Experience:**

The words "including clear definition of the improvement needed or expected" – subpractice 3 - seems to anticipate the root causes before the root causes are determined. [CAR SP 1.1]

Including positive outcomes is an improvement to the model. [CAR SP 1.2]

The new wording poses a risk that organizations will be required to show evidence of analysis of both problem and success outcomes in an appraisal.

Implement the action plans – sub practice 4 – ties to the practice text of "Implement". This is an improvement in the wording. [CAR SP 2.1]

#### **Team Recommendation:**

No recommended changes were given by the team.





### CAR - v1.3 vs v1.2 Change Highlights



### v1.3 SP 1.1 Select outcomes for analysis.

v1.2 SP1.1 Select the defects and other problems for analysis.

# v1.3 SP 1.2 Perform causal analysis of selected outcomes and propose actions to address them.

v1.2 SP 1.2 Perform causal analysis of selected defects and other problems and propose actions to address them.

# v1.3 SP 2.3 Record causal analysis and resolution data for use across projects and the organization.

v1.2 SP 2.3 Record causal analysis and resolution data for use across the project and organization.





# Organizational Performance Management - OPM



### **Team Feedback/Experience:**

Suggest moving OPM SP 1.1 to make it a new OPP SP 1.1. Need to have a practice in OPP to revise the business objectives identified in OPF and expanded in OPM. [OPM SP 1.1]

Incremental improvements are handled by the pilot organization in OPF, and not explicitly called out as relating to the QPPOs and business objectives like an innovation would be. [OPM SP 2.1]

Adding incremental and innovative improvements in two separate practices may cause confusion for implementers and appraisers. Recommend deleting this practice. With the exception of tying them to business needs, incremental changes are analyzed and implemented in OPF (see current examples given in OPM SP 2.1 text). [OPM SP 2.1]





### Organizational Performance Management - OPM



### **Team Feedback/Experience:**

Add Business Objectives to this practice in same way that QPPOs are currently included. [OPM SP 2.5]

### **Team Recommendation:**

- Move SP 1.2 Analyze Process-Performance Data to SG 2 SP 2.1.
- Remove SP 2.2 Elicit and Analyze Incremental Improvements.
- Remove SP 2.3 Implement Improvements. [Note: The GLOP said "implement" and SP 2.5 said "deploy"]





## OPM - Latest Model Revisions



SG 1 Manage the organization's business performance using statistical and other quantitative techniques to understand process-performance shortfalls and identify areas for process improvement.

- SP 1.1 Maintain business objectives based on an understanding of business strategies and actual performance results.
- SP 1.2 Analyze process-performance data to determine the organization's ability to meet identified business objectives.
- SP 1.3 Identify potential areas for improvement that could contribute to meeting business objectives.

#### **Team Recommendation:**

 Remove SG 1 and associated specific practices and renumber SG 2 and SG 3.





# OPM - Latest Model Revisions



SG 2 Improvements are proactively identified, evaluated using statistical and other quantitative techniques, and selected for deployment based on their contribution to meeting quality and process-performance objectives.

- SP 2.1 Elicit and categorize suggested improvements.
- SP 2.2 Analyze suggested improvements for their possible impact on achieving the organization's quality and process-performance objectives.
- SP 2.3 Validate selected improvements.
- SP 2.4 Select and implement improvements for deployment throughout the organization based on an evaluation of costs, benefits and other factors.

### **Team Recommendation:**

 Rename proposed current SG 2 to Manage Business Performance and Select Improvements.



## OPM - Latest Model Revisions



SG 3 Measurable improvements to the organization's processes and technologies are deployed and evaluated using statistical and other quantitative techniques.

- SP 3.1 Establish and maintain plans for deploying selected improvements.
- SP 3.2 Manage the deployment of selected improvements.
- SP 3.3 Evaluate the effects of deployed improvements on quality and process performance using statistical and other quantitative techniques.





# Organizational Process Focus - OPF



### Feedback:

If OPF SP 1.1 were changed to read "Establish and maintain business objectives" this would better support "Maintain business objectives " in OPP and "Analyze the process-performance data" in QPM.

### **Team Experience:**

- The organization of the SPs between OPF, OPP and OPM was confusing for the team.
- It was the team's view that because an SP to establish the business objectives does not appear in ML3 that this might cause a disconnect in implementation (e.g., the model says maintain objectives in OPP and use the business objectives OPM but did not clearly establish the objectives beforehand).

### **Team Recommendation**

Replace SP1.1 with "Establish and Maintain Business Objectives"



## Appraisal Reporting

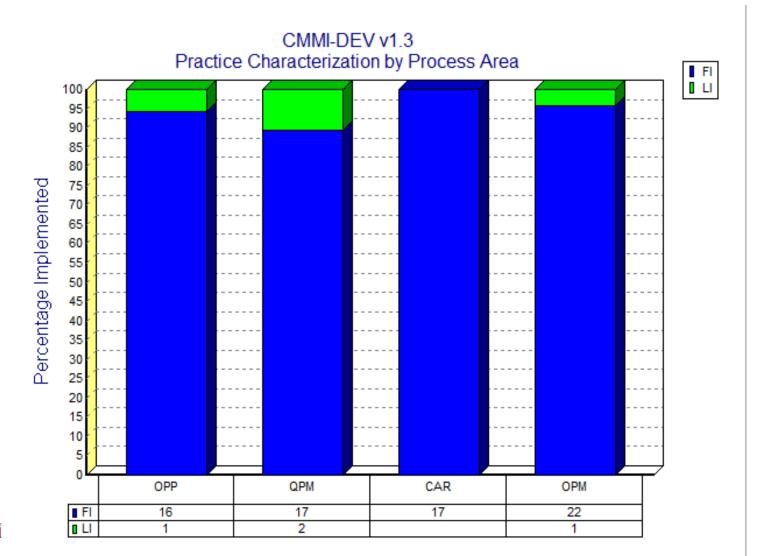


- The team created a detailed feedback report including redlines for each process area of the CMMI®- DEV v1.3 materials that we were provided.
- Collaborating to build a report that included information from both an appraisal team and the organization allowed us to provide detailed feedback while taking both an appraisal and implementation perspective.
- Mapping of CMMI®- DEV v1.2 to CMMI®- DEV v1.3 was completed by the team to provide CMMI®-DEV v1.3 equivalent ratings.
- Ratings against CMMI®- DEV v1.3 helped identify areas where the potential changes in the model would impact the organization being appraised.



# RDECOM Appraisal Results Using CMMI v1.3









# Candidate Findings for CMMI-DEV v1.3



- The maintenance of traceability to business objectives for the organization's quantitative objectives for quality and process performance was not explicitly evident. [OPP SP 1.2]
- Attributes critical to evaluating performance to help achieve the project's quality and process performance objectives were not clearly identifiable. [OPP SP 1.3]
- Risks associated with achieving the project's quality and process performance objectives are not explicitly identified or managed. [QPM SP 2.1]
- Incremental improvements are not explicitly called out as relating to the QPPOs and business objectives. [OPM SP2.1]





## Results Summary



- In evaluating CMMI-DEV v1.3 we had the biggest problem with OPM.
  - We were able to agree that the second two goals would be valuable with some rewording.
- There was a lot of discussion about "Review Business Objectives" in OPM.
  - We suggested moving Establish and Maintain Business Objectives to OPF.
  - We suggested moving Maintain Business Objectives to OPP.
  - We suggested removing Review Business Objectives from OPM because it is already in OPP.



### Lessons Learned



- Planning for and obtaining the necessary resources to train the team, while the model was still being developed, was not easy.
- Using draft material from a model with a moving baseline was difficult to manage and caused rework for the team.
- A template or any specific guidance on what is the desired output for piloting a new model would have been helpful.





## Pilot Summary



- We completed a thorough review of CMMI®- DEV v1.2 and CMMI®- DEV v1.3 through the eyes of an appraisal team and the implementing organization.
- The team agreed with most of the changes in CMMI®- DEV v1.3 and felt that the changes clarified the intent of the practices.
- Our recommendations were provided directly to the CMMI<sup>®</sup> development team immediately upon completing the appraisal to support their decisions for further development of the final draft.
- Most of our pilot recommendations were considered and incorporated into the model.